Railway Mechanical Engineer

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Shop Management Competition

In our July number we announced a shop management competition to close on September 15. The competition was inspired by the discussion on shop management which took place at the meeting of the Mechanical Division at Chicago in June. Industrial organizations have found that it paid well to give considerable attention and go to quite some expense to provide special training or coaching for their supervisory officers and foremen in the principles of management. Several foremen's clubs were started on the Pennsylvania Railroad last year, the purpose of which was not to discuss matters concerning craftsmanship, or even methods of shop operation; the discussions largely concerned the principles for successfully directing the activities of the workmen and dealing with the human element. Facilities and methods are of course important, but as one of the speakers said at the Mechanical Division meeting, better results can be obtained by a well organized and enthusiastic group of workers with poor facilities than by a group of indifferent workers with the very latest and most up-to-date facilities and equipment. There are a lot of books published and articles written on the principles of successful management. What we want, however, is examples of the way in which some of these principles have been applied with success. We are not so much interested in the theoretical side of the question, but we are tremendously interested in giving our readers concrete pictures and applications of simple principles which have been found to give real results. Two prizes are offered, a first prize of $75 and a second prize of $50 for the two best articles of this kind. They will be judged upon the practical value of the suggestions that are made. Articles which do not receive a prize but which are published, will be paid for at our regular space rates.

How Is Your Terminal Operated?

One of the strongest assets of an enginehouse foreman is ingenuity—the ability to meet emergencies effectively. Almost never provided with a plant adequate for the maximum service required at certain seasons, or perhaps even during the daily peaks, he must use such facilities as are available so effectively that trains are despatched without delay under widely, and sometimes suddenly, fluctuating transportation demands. In many cases this requires the daily solution of new problems presented by temporary conditions which may change over night.

But notwithstanding the satisfaction which comes from waging a winning fight against constantly shifting odds, every foreman no doubt recognizes the fact that most effective results are obtained where the element of chance is reduced to a minimum—where forces are organized and work planned to anticipate future conditions as far as this is possible. Here is a field for the exercise of the ingenuity of the officers of the mechanical department from the roundhouse foreman to the head of the department, so that something like a permanent return may be obtained. What kind of organization of your enginehouse forces have you found to give the best results? Are your men all specialists, or do they work in gangs, taking any assignment that offers within their craft? Is your running repair work all emergency work, or are you prepared for it in advance? Have you been able to supplement the facilities at your disposal with any particularly effective devices that did not require an A.F.E.?

The *Railway Mechanical Engineer* will pay a first prize of $50 and a second prize of $35 for the two best articles in answer to any one, or all of these questions, containing the most constructive suggestions (1) for expediting the turning and despatching of locomotives (2) for simplifying inspection and repairs (3) for keeping engine failures at a minimum when heavy seasonal business does not permit much time in the hands of the mechanical department. We are not so much interested in the results obtained from the operation of the best laid out and best equipped engine terminals in the country as we are in the means by which you have materially improved any one or all of the three above named phases of engine terminal operation. Neither are we primarily interested in the literary merits of the articles submitted. The articles may be of any length, although from 1,000 to 1,500 words is suggested as about the maximum required. The articles must be received at the office of publication prior to October 15. Should any articles other than those awarded the prizes be published, they will be paid for at space rates.

The Apprentice Competitions

The two apprenticeship competitions, one for regular apprentices and the other for college men who are serving as apprentices, which were announced and commented upon in our June and July issues, close September 1. It is not too late for you to prepare your contribution and get it to us by that date. Our hope is that we shall receive a large number of constructive criticisms or suggestions from apprentices, both regular and special, which will encourage the managements to give still greater attention to the whole question of recruiting and training men for the mechanical department. The best modern apprenticeship systems have been fostered and developed by men of rare vision, who have had a keen sympathy for the young men. On the other hand, it is, of course, unfortunate that so few roads have gone into this question to the same extent as has the Santa Fe, for instance. A number of roads have taken this question up during the past year or two and a very considerable amount of progress has been made in improving the methods of training on these roads. We have the feeling that greater results could sometimes be accomplished if those in charge of developing the apprenticeship methods had a better understanding of how the young men viewed these things and as to just what their reactions were. Here is a splendid opportunity for the young

men to have their say and to be helpful, by giving those in charge a frank statement of how they look at the situation and how they think the methods may be improved.

Measuring Shop Output

On another page of this issue is Mr. Westbrook's article which was awarded first prize in the Erecting Shop competition. One of the most interesting features of this article is the output meter used for giving an intelligent comparison of shop production month by month. There can be no adequate control of shop operations without a knowledge of what is being accomplished, and the mere statement that 30 locomotives were turned out at a certain shop in one month as compared to 25 locomotives in another month by no means proves the operation in the former case to have been more efficient. What was the relative number of men employed? How many man-hours of labor were required? Did light or heavy repairs predominate? Were the locomotives old and small with few accessories, or were they large modern locomotives equipped with all the latest labor and fuel saving devices? It is plain that without some means of reducing these varying factors to some common denominator no accurate comparison of shop output month by month can be made and the shop superintendent will not know whether his organization is getting good results or needs to be toned up.

Reference to the article will show how this problem of measuring shop output has been met at the Grand Trunk shops, Battle Creek, Mich. In the first place, it will be noted that a distinction is made between large and small power, thereby making it unnecessary to give the same credit for Class 3 repairs to a heavy Pacific type locomotive as to a small six-wheel switcher. A point system is used in conjunction with the standard classification promulgated by the Railroad Administration, based on a careful and extended study of the relative number of man-hours of labor required for each class of repairs on both heavy and light power.

Without stealing too much of the author's thunder, it may be said that the output meter shows for each month the total number of locomotives repaired and the class of repairs given in each case; also, the points made, number of men employed and hours worked. The product of the last two figures gives the total number of man-hours per point and monthly percentage of gain or loss can be readily calculated. The output meter described can doubtless be adapted, with possibly a few minor changes, to any shop not already using some such method of measuring shop output.

The Problem of Boiler Repairs

One of the serious problems confronting some, if not most of the railroads, is that of maintaining locomotive boilers in condition for safe and efficient operation. Modern boilers are large, with large areas of tubes and sheets exposed to the corrosive action of poor feed-waters. Flue sheets, side sheets and other firebox sheets must be patched or renewed frequently. Federal requirements call for staybolt cap removal every 18 months, new flues at least every three years and lagging removal for hydrostatic test every five years. Obviously, this work cannot be done without the use of a large force of men trained in repairing boilers.

It is a well-known fact that for years the boilermakers', and to an even greater extent the blacksmiths', trades have been attracting fewer and fewer young men to serve apprenticeships and become all-around journeymen in these trades. With an increasing demand for their services, experienced boilermakers have been able to demand and receive considerably greater wages than are paid by the railroads, and these men have gradually drifted out of railroad service. On July 1, 1922, the strike of railroad shopmen was called and in practically all cases the boiler shop employees left en masse. Some of them have since returned but a large proportion undoubtedly secured employment elsewhere at their trade or entered new trades. The latter alternative was followed, particularly in the Middle West where energetic young men with some mechanical ability were greatly needed for specialized jobs in the automotive industry.

Faced with a total disorganization of boiler repair forces in July, 1922, and the practical impossibility of employing an adequate number of skilled boilermakers since, the railroads found the question of boiler maintenance a most serious one. Some railroads frankly admitted their inability to cope with the situation and sent heavy boiler repair jobs to the locomotive builders who were in a better position to handle them. Other roads deferred heavy boiler repairs as much as consistent with safety until their boiler shop forces could be built up to handle the work. New men were employed in the boiler departments and while lacking in experience, they were as a rule commendably willing to work and learn. With the aid of a skeleton organization of foremen, inspectors and gang leaders who remained faithful to the railroads, these new men were developed along specialized lines until some railroad boiler shops are now getting better production than before the strike. It is true that all around boilermakers cannot be developed in a short period of training no matter how intensive, but such a training can develop specialists in the different branches of boiler work, each of these men being able to handle his own specialty better than boilermakers with wider and more general experience. On the whole it appears that the best if not the only immediately available solution of the boiler maintenance problem confronting the railroads is in the careful selection and development of specialists in the different branches of boiler repair work.

Production Methods in Car Repairs

In the discussion on modern repair track facilities during the Mechanical Division meeting at Chicago, attention was directed to the fact that the railroads had been very slow to adopt the station to station method of making heavy car repairs regularly used in contract shops. It is encouraging to note at the present time that considerable interest is being displayed in this method and that it has been adopted at a number of points, notably at the Readville shops of the New York, New Haven & Hartford as described elsewhere in this issue. In itself, however, it does not exhaust the possibilities of improvement in the cost of making heavy car repairs that are suggested by contract shop operation.

During recent years a large number of heavy repair or rebuilding operations have been performed for the railroads in contract shops. The outstanding fact with respect to these contracts is that they cover the performance of identical operations on a large number of cars of the same series. This means much in reducing the cost per car to a minimum. New material can be purchased and fabricated in quantities; the fixed facilities such as hoists, staging, bull riveters, etc., can be located and adjusted to best facilitate the particular operations to be performed; the number and size of gangs can be adjusted to obtain a perfect balance; special hand tools may be provided to fit the specific requirements of a single series of cars, and the gangs, organized for the repetition of certain specialized operations, are able to develop a facility of performance entirely impossible when no two successive operations are alike.

Contrast this with the usual run of heavy car repairs as handled at the railroad car shop or repair track. Cars are taken into the shop without regard to series, just as they become available by chance arrival at the home shop. Even where some attempt is made to accumulate a run of cars of a single series, each car is likely to be subjected to individual

treatment based on a detail inspection, so that there is considerable variation both in the kind of material and the nature of the track work required for the different units, and the continuity of the run on any one series of cars is not likely to be long enough to suggest the development of special tools or appliances adapted to facilitate the operations encountered exclusively on this single series.

There can be no doubt but that the railroad is handicapped in developing as high a degree of specialization as is done in the contract shop because it must take care of all cars that require immediate attention irrespective of the class or even of ownership. But if a railroad can call in the cars of a single series in sufficient numbers to meet the requirements of a contract shop, would it not be equally possible to make the same arrangement with respect to the operation of at least a part of its own heavy car repair facilities? This might call for the setting aside of a part of a given shop to be organized to handle a single class of cars until that series has all received the needed heavy repairs or rebuilding, or a single shop might be devoted entirely to this class of work, leaving the other shops to take care of the current run of miscellaneous heavy repair work. The advantages of thus organizing heavy repairs are so far-reaching in their effect on the cost per unit that they should receive the careful consideration of every railroad.

What Our Readers Think

C., M. & St. P. Method of Center Sill Stress Analysis

Chicago.

To the Editor:

In your February issue you published an article by Wendel J. Meyers in which the author comments on the methods of calculating the stresses in the C., M. & St. P. gondola cars described in your November, 1922, issue. It is gratifying to note the interest taken by engineers in such articles and any investigation or analysis tending to broaden the knowledge of the art of car design should be encouraged.

The method of analyzing some of the stresses employed by Mr. Meyers, however, does not represent the actual condition. He attempts to prove that the center sills are subject to higher stress at the bolster than shown by the calculations published in the description of the cars, by assuming the center sills as a beam with fixed ends, the distance between the bolster being a free span. This is an unwarranted assumption as the ends of a car are by no means rigid. The flat car or all steel hopper car, for example, has a weak side sill construction and in most designs the end sill adds but little to the rigidity of the underframing. A center sill, therefore, in the usual design of cars cannot be considered as a beam with fixed ends.

It is not necessary to make any auxiliary assumption to prove that high stress exists at the bolster or elsewhere in the center sills. The fact is that the end load or end shock, which is assumed in this case to be 250,000 lb., is actually several times greater when cars are subjected to rough handling in switching service.

An end shock of 250,000 lb. is recommended by the A. R. A. as a minimum end load for freight cars, based on a 15,000-lb. fiber stress or a factor of safety of four if the ultimate strength of the steel is 60,000 lb. per sq. in. It is obvious that the 250,000-lb. end shock is only an assumed load, but through experience it has been ascertained that cars meeting the A. R. A. requirements give a reasonable service without going to an unduly heavy design.

It is a well-known fact that end loads or end shocks are to some extent dissipated by the framing members of the car and in wood cars with spring draft gears, the car repairer sees real evidence of what dissipated energy means in the form of destroyed car members. The function of the friction draft gear is to dissipate the end shock and its ability to perform this work depends upon the capacity of the gear. The car structure will also dissipate a portion of the end shocks but due to the nature of steel, the percentage of the energy absorbed is small until the elastic limit has been reached. A vivid idea of the extent to which each individual car can dissipate a blow from end shock can be obtained in a hump yard when a car is sent down the hump to the classification tracks at a speed of two miles an hour or more, if the clattering is observed when the string of cars successively transmit the blow from one to the other down the track. To assume that the entire end shock is dissipated within the car structure itself is erroneous and would result in unduly heavy center sill sections at the bolster and too weak construction at the center of the car.

In publishing these articles describing C., M. & St. P. designs there was not the slightest intention of producing something new which heretofore has not been done, but rather more effectively to illustrate our construction. To make a statement, as the author of the article in your February issue did, that the field of research in car design has hardly been touched, is an insult to a number of capable car designing engineers who for years have minutely studied the details of car construction. However, if this article and others like it would induce experienced car engineers to write on various subjects pertaining to car design, the efforts of the C., M. & St. P. would be well worth while.

L. K. Sillcox,
General Superintendent Motive Power,
Chicago, Milwaukee & St. Paul.

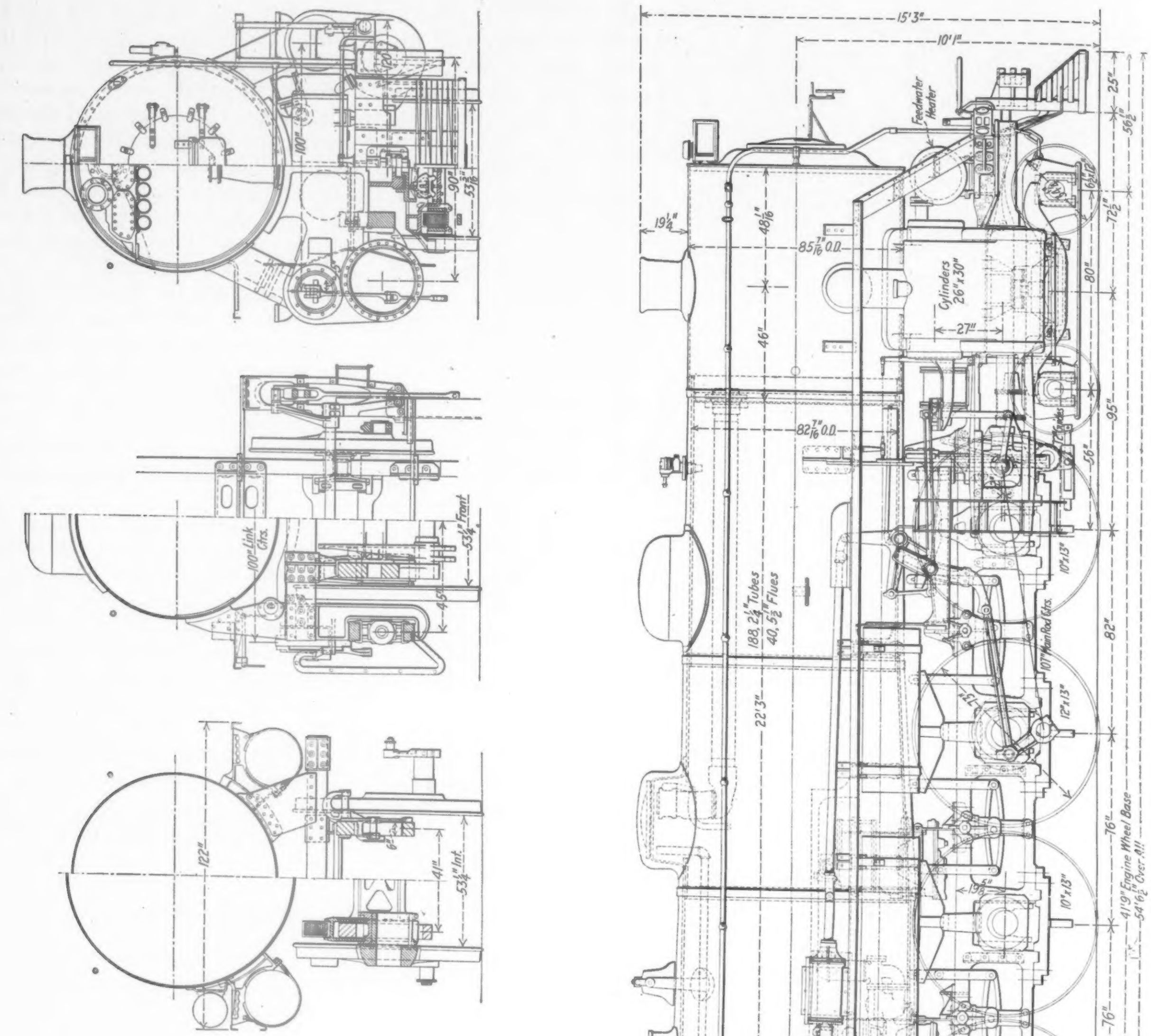
New Books

Automatic Screw Machines. 354 *pages, 6 in. by 9 in., illustrated, bound in paper. Published by Brown & Sharpe Manufacturing Company, Providence, R. I.*

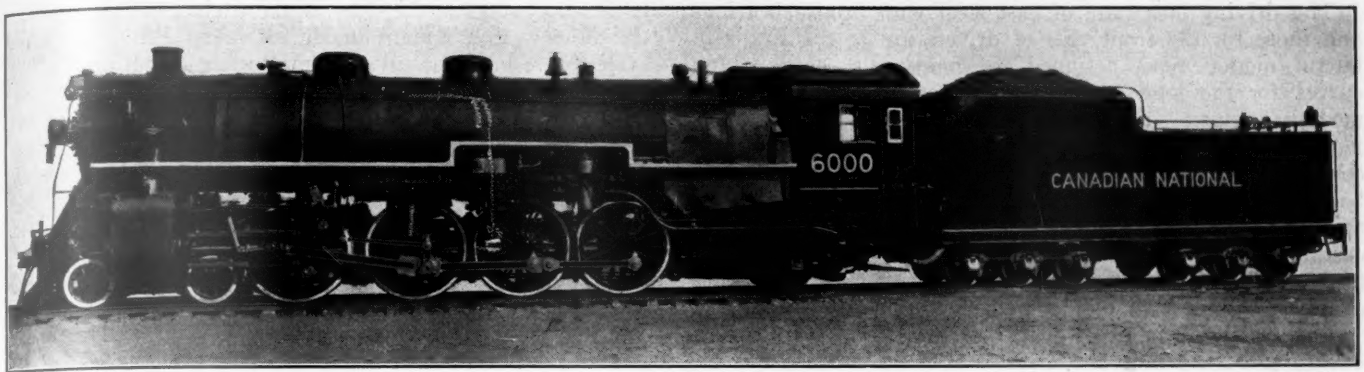
This is a very complete and up-to-date book on the construction and use of automatic screw machines together with automatic turret forming machines and automatic cutting-off machines. It has been prepared for the use of superintendents, foremen and operators of such machines and is a companion book of a series which includes several previous treatises on other types of machine tools. The setting up of the machines is described in detail and complete instructions are given on the use of the standard tools. A chapter on designing cams and many useful tables makes the book of special interest to the operator.

Locomotive Catechism. *By Robert Grimshaw, 958 pages, 5½ in. by 7¾ in., 468 illustrations, bound in cloth. Published by the Norman W. Henly Publishing Company, New York.*

This is the thirtieth edition of a book which for a number of years has been considered the standard authority in its class. It is written in a simple and easily understandable manner such as will appeal to firemen, engineers, trainmen, switchmen, shop hands and enginehouse men for whom it has been prepared. The text follows the form of examination questions and answers, of which there are some four thousand. Considerable new matter has been added in this addition and the old matter carefully revised. The chapters, of which there are 89, are short and conveniently headed for ready reference and cover the various details, such as boilers, cylinders, valve gear, running gear, superheaters, air brakes, etc. The book tells not only what to do, but also what not to do and is specially helpful for a person preparing for an examination for promotion.



Croess-Sections and Elevation of Canadian National Mountain Type Locomotive



A Well Designed Mountain Type Locomotive of Medium Weight

Canadian National Mountain Type Locomotive

Increasingly Heavy Passenger Traffic Requires Adoption of 4-8-2 Type Locomotives for Eastern Canada

By C. E. Brooks
Chief of Motive Power, Canadian National Railways

PROMINENT among the locomotives which the Canadian National Railways are acquiring during 1923, are the 16 Mountain type being built by the Canadian Locomotive Company, Kingston, Ontario. A large number of the details used in the construction of these locomotives are of Canadian National standard design and common to all their large modern power. However, there are many new features necessarily introduced in the building of a new type with the dimensions and power of the mountain type.

These locomotives are known on the Canadian National as the U-1-a class, road Nos. 6,000 to 6,015. They have a total weight (without tender) of 339,000 lb., the weight on the drivers being 226,770 lb. The tractive power is 49,600 lb. and the factor of adhesion is, therefore, 4.5. The cylinders are 26 in. diameter by 30 in. stroke and the driving wheels, 73 in. in diameter.

Features of the Boiler and Other Attachments

The boiler which carries 210 lb. pressure is of the straight-top radial-stayed type with a conical bottom, the largest course being 90 in. in diameter. The firebox is 48¼ in. by 114⅛ in. inside, and the combustion chamber is 48½ in. long. The boiler horsepower is 96.4 per cent of the cylinder horsepower.

There are 188, 2¼-in. tubes and 40, 5½-in. flues, 22 ft. 3 in. long, the flues being electric welded into the back tube sheet as per Canadian National standard.

A feature of Canadian National practice in crown staying, which has been followed on these boilers, is the alternation of successive groups of four transverse rows of crown stays; *i.e.*, four rows of button head crown stays are succeeded by four rows of plain heads and so on alternately. This arrangement provides against the possibility of a boiler explosion in the event of a burnt crown sheet, by reason of the sheet giving first at a point where stayed with plain head stays and pulling down over some of these stays, at the same time being held on either side by the button head stays, the pressure being relieved through the holes where the sheet comes over the plain heads.

In view of the size of these locomotives and in order to take advantage of every means for efficient operation, they have been equipped with mechanical stokers and feedwater heaters, the boiler feed apparatus on the left hand side consisting of a pump in connection with the feedwater heater and on the right-hand side a Hancock type EA lifting injector of 3,500 gal. capacity.

The grates are of Canadian National standard design, the rocking grate bars being of cast steel and operated by Franklin power grate shakers.

The superheater used is the Robinson, one of the standard superheaters in England but comparatively new on Canadian roads. It embodies many interesting features, prominent among these being the maintaining of steam in the superheater units at all times, this being calculated to lengthen the life of the units.

The ash pans are of the Canadian National standard hopper type, the location of the door hinges being such that the doors close of their own weight. An attachment, which is Canadian National standard practice and is known as the ash pan sludge, is worthy of note. This consists of an 1¼-in. pipe from the delivery pipe of the injector to the ash pans, with a valve operated from the cab, and a branch extending into each hopper. The arrangement is specially valuable as it permits the direction of hot water into the ash pans to thaw them out when the locomotive arrives at a terminal in freezing weather with pans partly filled.

Engine and Running Gear

The frames, with a single forward section, are of carbon steel thoroughly annealed, rigidly braced with cast steel crossties and fitted with taper bolts throughout. The rear end is fitted with a Commonwealth cast steel cradle casting.

The equalizing system is of the usual type, the engine truck forming one system of equalization while the four driving wheels on each side are equalized with the trailing truck, thus forming the other two systems, this arrangement giving a three point suspension. The equalization places approximately 57,300 lb. on the engine truck, 226,770 lb. on the drivers and 54,930 lb. on the trailing truck.

The driving wheels are 73 in. diameter with 66 in. centers of cast steel. The axles are 10 in. diameter at the journals except the main journals which are 12 in. diameter, and due to weight consideration and in keeping with modern practice, are hollow bored.

The driving boxes are of cast steel with bronze bearings and those for the front pair of drivers are of the Franklin lateral motion type, designed to compensate when taking curves for the long wheel base necessary on such large modern engines. Franklin adjustable driving box wedges and Franklin hard grease cellars are used throughout. A comparatively new feature in connection with the driving boxes and worthy of particular mention, is the application of the Franklin driving box spreader. This is a permanent casting fixed at the bottom of the box, prevents any spring to the sides of the box and makes the removal and repacking of grease cellars a simple, as well as a quick operation.

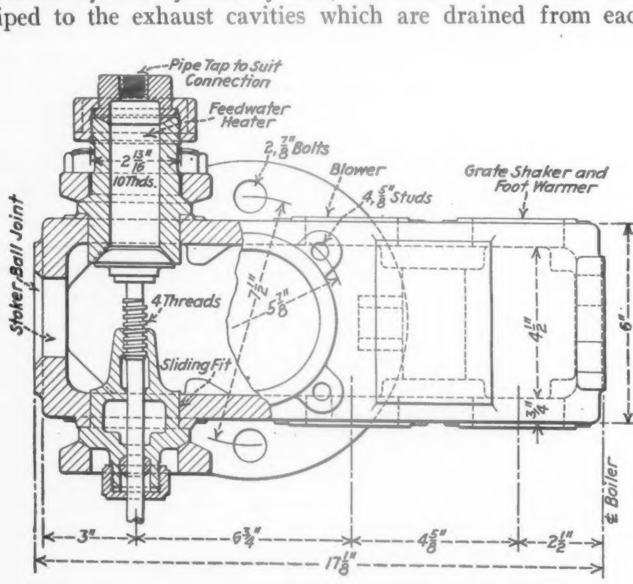
The crosshead is fitted with the Rogatchoff adjustment, a feature which permits the adjustment of the shoes to take up the wear.

The crosshead guides and piston rods are of such length that the piston may be carried out clear of the front cylinder head without disconnecting the piston rod from the crosshead.

The engine truck is of the Commonwealth constant-resistance, four-wheel type, equipped with Preston hub slip liners and Armstrong oilers. The wheels are 34¼ in. diameter, and have spoked steel centers 28 in. diameter, common to all Canadian National modern passenger locomotives. The trailing truck is also of the Commonwealth constant-resistance type with 43-in. diameter wheels and 36-in. cast steel wheel centers.

Steam distribution is provided for by Walschaert valve gear of modern design. The diameter of the piston valve is 14 in. and the valve setting is as follows: Travel, 6½ in.; lap, 1⅛ in.; lead, ¼ in.; exhaust clearance, ¼ in.

The cylinders follow Canadian National standard design, being equipped with railway standard by-pass valves and four standard cylinder cocks to each cylinder, two being placed at the center of the barrel and connected with a drain pipe from the bottom of the steam chest, this pipe being covered by the cylinder jacket, the other two cocks being piped to the exhaust cavities which are drained from each



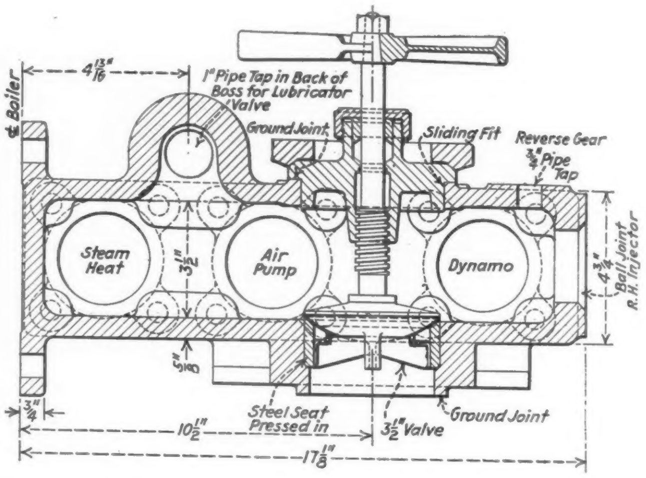
Left Hand Half of Turret—Partial Horizontal Section Through One of the Operating Valves

quarter. All eight cylinder cocks are operated in unison by one set of levers. The cylinders also are equipped with railway standard relief valves. The bottom of the cylinder casting is arranged so that the engine truck center plate is checked into same, thereby affording ample provision to withstand the thrust which this part is subjected to.

Cab and Piping Arrangement

The cab is of the railway company's standard short vestibule type. This type of cab makes it possible to have almost all the short stays in the sides of the firebox out clear of the cab, the few that remain inside all being F.B.C. flexibles.

Great care has been given to the piping layout and, as far as practical, it was laid out in the drawing room in advance of construction. The cast steel turret with eight outlets has been placed outside and 25 in. ahead of the cab, affording ample room for packing the operating valves which are all of one standard design. Six operating valves enter the turret horizontally from the rear with the valve seats and steam connections at the front, these connections being fitted with a coupling nut and a tail piece tapped to suit the several pipe sizes, thereby permitting the use of one size standard operating valve. These operating valves are fitted with extension handles carried into the cab and labeled. One feature of the valves and seats is that none of them are threaded into the turret, each one being secured with a cast-steel flange and four studs tapped into the turret walls, bosses being provided inside the turret so that studs do not go all the way through. This eliminates leaky threads in the turret as well as simplifying the removal of the valves when necessary. Not only has the turret been placed outside the cab, but the injector and stoker engine valves as well, these being attached to the ends of the turret. This arrange-



Right Hand Half of Turret—Vertical Section Through Main Valve

ment renders the valves more accessible for packing and removes the great danger of scalding in case of a side-swipe or similar accident that would tend to burst a steam pipe inside the cab.

Other Features

The sand box is fitted with Hanlon sanders. World type safety valves are used, three in number, one muffled and two plain. The headlight equipment consists of a Pyle-National type K-2 turbo generator set and Keystone type No. 1412 cage, fitted with a 14 in. Golden Glow reflector and C.M.S. focusing device, the cage body being No. 16 gage copper. Canadian National standard separate number lamp case with sides oblique is used, this making for the maximum safety in operation by reason of the easier and more certain identification of locomotive numbers. The water level indication is procured by the most modern method and consists of the Canadian National standard water column welded directly to the back head of the boiler and fitted with the railway standard try cocks and water glass fittings, the water glass being fitted with a special guard. The steam heat reducing valve is of the World-Leslie type and the piston and valve rod packing is King metallic. The Franklin radial buffer and unit safety bar are used between engine and tender and between engine and tender on the steam heat line, Barco flxible joints are used.

The air brakes are Westinghouse No. 6 E.T. with 8½ in.

cross compound air compressor and S-5 governor. There are three main reservoirs, two on the right side and one on the left side with a total capacity of over 90,000 cu. in. The radiating pipe connecting reservoirs and compressor is so arranged as not to be visible, and is supported by cast-iron brackets under the running boards. This radiating feature has been of good service in overcoming condensation and consequent freezing during low temperatures. The air brake piping on these locomotives has been given careful study which has resulted in a piping layout that is easy of access and of a neat appearance.

Tender Design

The tank is of the water bottom type of Canadian National standard design and construction, somewhat modified for the application of the Duplex mechanical stoker. The tank has a water capacity of 10,000 Imperial gallons and a coal capacity of 17 tons. The tender frame is of the Commonwealth cast steel type. Commonwealth six-wheel tender trucks are used with 5½ in. by 10 in. journals. Flat side bearings are used, placed 52 in. apart both front and back.

The important dimensions, weights and proportions of these locomotives are shown in the accompanying table.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	Canadian National
Builder	Canadian Locomotive Company
Type of locomotive	4-8-2
Service	Passenger
Cylinders, diameter and stroke	26 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6½ in.
Outside lap	1⅛ in.
Exhaust clearance	¼ in.
Lead in full gear	¼ in.
Weights in working order:	
On drivers	226,770 lb.
On front truck	57,300 lb.
On trailing truck	54,930 lb.
Total engine	339,000 lb.
Tender	238,000 lb.
Wheel bases:	
Driving	19 ft. 6 in.
Rigid	12 ft. 8 in.
Total engine	41 ft. 9 in.
Total engine and tender	79 ft. 1¾ in.
Wheels, diameter outside tires:	
Driving	73 in.
Front truck	34¼ in.
Trailing truck	43 in.
Journals, diameter and length:	
Driving, main	12 in. by 13 in.
Driving, others	10 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	210 lb.
Fuel, kind and B. t. u.	Bitum. coal
Diameter, first ring, inside	80⅞ in.
Firebox, length and width	114⅛ in. by 84¼ in.
Height mud ring to crown sheet, back	61 in.
Height mud ring to crown sheet, front	83½ in.
Arch tubes, number and diameter	4—3 in.
Combustion chamber length	48½ in.
Tubes, number and diameter	188—2¼ in.
Flues, number and diameter	40—5½ in.
Length over tube sheets	22 ft. 3 in.
Grate area	66.7 sq. ft.
Heating surfaces:	
Firebox, comb. chamber and arch tubes	348 sq. ft.
Tubes	2,455 sq. ft.
Flues	1,276 sq. ft.
Total evaporative	4,079 sq. ft.
Superheating	810 sq. ft.
Comb. evaporative and superheating	4,889 sq. ft.
Special equipment:	
Brick arch	Yes
Superheater	Robinson
Feedwater heater	Elesco H 5
Stoker	Duplex
Tender:	
Style	Water bottom
Water capacity	10,000 imp. gal.
Fuel capacity	17 tons
Truck	6 wheel
General data estimated:	
Rated tractive force, 85 per cent	49,600 lb.
Cylinder horsepower (Cole)	2,556 lb.
Boiler horsepower (Cole) (est.)	2,470 lb.
Speed at 1,000 ft. piston speed	43.4 m.p.h.
Steam required per hour	53,200 lb.
Boiler evaporative capacity per hour	51,480 lb.
Coal required per hour, total	8,300 lb.
Coal rate per sq. ft. grate per hour	124 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	66.9
Weight on drivers ÷ tractive force	4.5
Total weight engine ÷ cylinder hp	128.6 lb.
Total weight engine ÷ boiler hp	133.1 lb.
Total weight engine ÷ comb. heat. surface	69.3 lb.
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	96.6
Comb. heat surface ÷ cylinder hp	1.91
Tractive force ÷ comb. heat. surface	10.13
Tractive force × dia. drivers ÷ comb. heat. surface	740
Cylinder hp. ÷ grate area	38.3
Firebox heat. surface ÷ grate area	4.72
Firebox heat. surface, per cent of evap. heat. surface	8.54
Superheat. surface, per cent of evap. heat. surface	19.86
Tube length ÷ inside diameter	138

Ljungstrom Turbine Locomotive Ordered for the Argentine State Railways

ACCORDING to an article in Engineering (London), the government of the Argentine Republic has placed an order for a turbine-driven locomotive of the Ljungstrom type for use on the state railways in that country. This latter order is a particularly interesting one, for not only is the locomotive of special design, but upon its performance will depend a further order from a large number of engines, the placing of which will be deferred until the first machine has been put to practical tests.

The new Argentine locomotive is to be built for the meter gage lines, and will use oil fuel, in the consumption of which the Ljungstrom Company has guaranteed to effect a saving of at least 50 per cent during the cold season and 40 per cent during the hot season as compared with ordinary locomotives doing similar work. Furthermore, in view of the difficulties of watering along many of the lines in the country, the condensing properties of the Ljungstrom locomotive show to great advantage. The total amount of water carried is 5.5 tons in the condenser and 5 tons in the feedwater tank, this being sufficient for a non-stop run of 500 miles lasting 20 hours. The actual water consumption for such a run with a train of 700 tons behind the tender will not exceed 4 tons; and the oil fuel carried, namely, 6.5 tons, will suffice for the same journey, the oil being taken to have a calorific value of 18,900 B.t.u. per pound. The general design of the locomotive will be similar to that very fully illustrated in the *Railway Mechanical Engineer* of October and November, 1922, pages 557 and 623, the air-preheating arrangements, the gearing and the arrangement of the condenser elements being, however, modified. The total weight of the machine in running order will be 120 tons and the maximum speed 41 m.p.h. The boiler car is carried on a leading truck followed by three fixed axles. The condenser car, with the turbine and gearing, is carried on four driving axles, followed by a pony truck. The total wheel base of the locomotive is 16.6 m., the rigid wheel base being 3.2 m. The driving wheels are 1,470 mm. diameter. The five axles under the boiler car are loaded with 11.5 tons each, and the driving and trailing truck axles with 12.5 tons each. The horsepower at the rim of the drivers is 1,750 boiler horsepower. A boiler heating surface of 100 sq. m. is provided, and a superheater surface of 57 sq. m. while the airpreheater, which replaces the more inefficient portion of the ordinary tube surface, has an area of 800 sq. m. The boiler works at a pressure of 300 lb. per sq. in.

Over a comparatively hilly route similar to that between Stockholm and Upsala, with a 500-ton load behind the tender, the average fuel consumption per 1,000 useful ton kilometers, will not exceed 8.9 kg. during cool weather and 10.7 kg. during hot weather, while for continuous service on such a route, when the condenser has not time for cooling and the air temperature is at 104 deg. F., the consumption will not exceed 11.6 kg. per 1,000 ton kilometers of useful load. The machine is being built by Messrs. Nydkvist and Holm of Stockholm.

Proceedings of the Air Brake Association

Report of the Papers and Discussions at the Thirtieth Annual Convention Held at Denver

IN the June issue of the *Railway Mechanical Engineer,* the proceedings of the opening session of the Air Brake Association convention, held at the Albany Hotel, Denver, Col., May 1, 2 and 3, were published together with the paper and discussion on Expediting Train Movement. Further proceedings of this meeting are given herewith.

Charging Freight Trains and Use of Release Position

By W. F. Peck
Baltimore & Ohio

A recent analysis of the factors surrounding an epidemic of stuck brakes on freight trains revealed the fact that insofar as operation is concerned, there was a considerable variance in the method used by enginemen in charging empty trains, and releasing brakes after slow-downs and stops, also, that trains were departing from water stations or other points where the engine was detached without waiting until all brakes had released. Where stops were made, whether the engine was detached from the train or not, it was the practice for the engineman to start on receiving a proceed signal from the train crew. The flagman, on being recalled to the train, might believe the brake on the last car had had time to release properly, while in fact it had leaked off, and brakes nearer the engine were still applied.

The purpose of the investigations forming the basis of this article, was to determine accurate data on: First, the quickest method of uniformly charging the empty or the partially charged brake system of freight trains of from 35 to 100 cars, to make the brakes available for use in the shortest possible time; second, the most effective method of releasing the brakes after ordinary service applications; third, the most effective method of releasing the brakes and recharging the system on the return of the engine to the train after having taken coal or water, and fourth, to establish certain fundamentals in regard to manipulation, which would automatically result in the best operation and increase the factor of train safety.

Numerous tests have been made to determine resultant cylinder pressures, and also the time required to apply the brakes with various reductions and types of triple valves. This information is available in the log sheet of every important demonstration; yet, similar data in regard to charging trains and releasing brakes does not appear available. The value of such information is emphasized where schedules are fast and trains frequent, since any attempt on the part of the engineman to depart before the brakes have had time to release may result in a break-in-two, or a burst wheel, due to over-heating. The demonstrations were made with these conditions in view.

The tests numbering 271, were made on the 100-car test rack of the New York Air Brake Company, at Watertown, N. Y., with trains of 35, 50, 75 and 100 cars.

Charging 100-Car Empty Trains

In the first series of tests, extreme measures were adopted in charging the train. With the low pressure governor top cut out, and the high pressure top adjusted at 130 lb., the automatic brake valve handle was placed in full release position and left there until the 100th car auxiliary reservoir showed 60 lb. pressure. Gage readings were taken at one minute intervals.

In this test, the main reservoir pressure never fell below 106 lb., nor the engine brake pipe pressure below 90 lb. At the end of the first minute, there was 46 lb. pressure in the first auxiliary and 1½ lb. in the 100th car auxiliary. It required 9 min. and 20 sec. to charge the 100th car auxiliary reservoir to 60 lb. This may be considered the minimum time in which this, or a similar train, could be charged under the conditions prevailing. The brake pipe leakage was 9 lb. per minute from 60 lb. At the end of the test, the first car auxiliary was charged to 118 lb., and the first 50 cars were charged to over 70 lb. (feed valve adjustment).

The other extreme is represented in a test, in which the same train was charged with the brake valve in running position, other conditions remaining the same, except that the test was concluded when the 100th car auxiliary reservoir was charged to 50 lb. This required 19 min. 45 sec., at the end of which time the first auxiliary reservoir was charged to 61 lb. This test demonstrated the time required to charge the train in the manner cited, and resulted in the greatest uniformity of pressures throughout.

The Air Brake Association at the Thirtieth

The best results were secured with the following brake valve manipulation: Full release position 1 min., running position 2 min., kick-off to full release position for 5 sec., and left in running position thereafter. Governor was adjusted at 100-130 lb. Test was commenced with handle of brake valve on lap position. It required 12 min. 20 sec. to charge the 100th car auxiliary reservoir to 50 lb. Brake pipe leakage 8 lb. from 60 lb.

Charging 75, 50 and 35-Car Empty Trains

The following factors governed charging the 75-car train: Governor adjusted at 100-130 lb., low pressure top cut in. Brake pipe leakage 11 lb. from 58 lb. Initial position of brake valve handle, lap. Brake valve manipulation as follows: Full release position 1 min., running position 2 min., kick-off to full release position for 5 sec.; thereafter in running position. At the end of 11 min. 55 sec., the 75th car auxiliary reservoir was charged to 60 lb., first car auxiliary reservoir to 64 lb.

For the 50-car train the brake pipe leakage 8½ lb. from 60 lb. Brake valve was held 1 min. in full release, 1 min. in running position, 5 sec. kick-off to full release position, and running position thereafter. It required 5 min. to charge the 50th car auxiliary reservoir to 60 lb., first car auxiliary to 64 lb.

For the 35-car train, brake pipe leakage was 7 lb. from 60 lb. Brake valve was held 1 min. in full release position, 1 min. in running position, 5 sec. kick-off to full release position, running position thereafter. Under these conditions, it required 2 min. 50 sec. to charge the 35th car auxiliary reservoir to 60 lb., first car auxiliary reservoir to 64 lb.

Release Tests

Release tests were made following 10, 12, 15, 20, 25, 30 and 40 lb. brake pipe reductions from an initial brake pipe pressure of 70 lb. In all of these tests, the brake system was first charged as thoroughly as brake pipe leakage would permit. It was not found possible to stay in full release position one second for each pound of brake pipe reduction without overcharging and consequent reapplication of brakes.

On the 100-car and 75-car trains, the release of brakes in the middle, and slightly back of the middle, could be prolonged by reducing the initial time in full release position one-half.

Conclusions

Certain definite conclusions may be drawn from the results of these investigations, without going into detail.

First—Attempting to charge the train by comparatively short movements of the automatic brake valve handle from release to running position and back, will only result in the pressure banking up and overcharging the head end of train. The longer the train, the more serious the results will be.

Second—Long trains are neither charged nor brakes released *primarily* with the automatic brake valve in full release position (standard locomotive brake equipment), since the time which it is possible to stay in full release position is short when compared to the total time required to charge or release all brakes.

Third—Any system of releasing brakes, which results in brakes reapplying, due to overcharging the head end of train, is not considered practicable, because it is impossible to designate a uniform kick-off, which will release all of these brakes without liability of other brakes re-applying, as a result of the kick-off. Any overcharging of the head end of the train necessarily prevents the prompt functioning of the feed valve. In both charging and releasing brakes, it is absolutely necessary that there be no interruption to the flow of air into the brake pipe. Brakes which re-apply simply rob the system of compressed air, which must be replaced before charging or the release of the brakes is completed. When the use of full release position was carried to an extreme, it was observed that one-second kick-offs were of no avail, and that five seconds was too long.

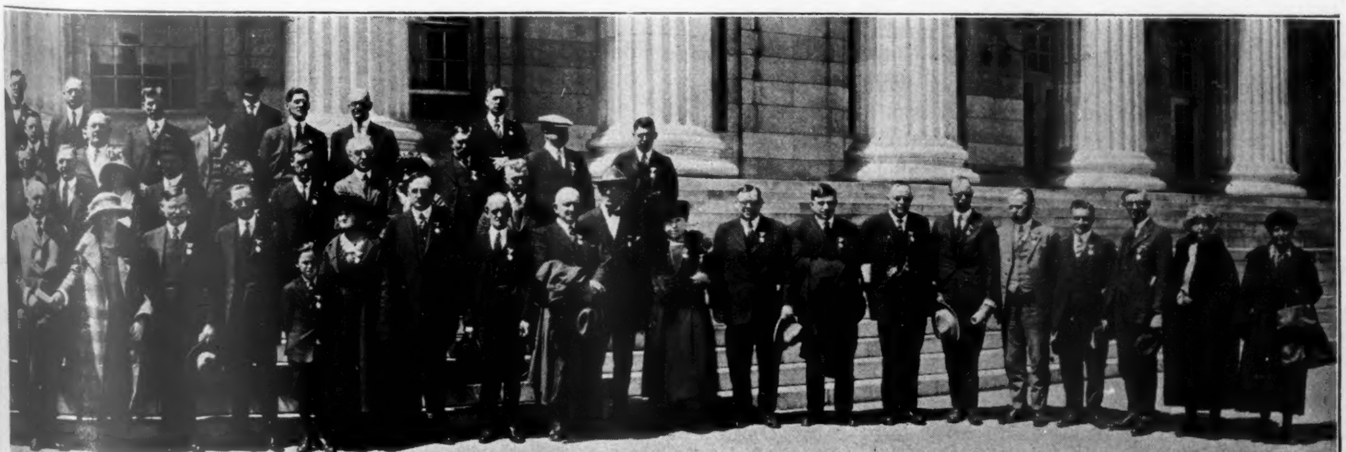
Fourth—It is highly important that feed valves be maintained at their maximum efficiency, since there will be an interruption to the flow of air into the brake pipe if they do not function properly.

Fifth—In releasing brakes, trains of less than 60 cars should not depart before three minutes after the brake valve has first been placed in full release position; longer trains four minutes.

Sixth—Since one 8½-in. 120-ft. air compressor is practically equivalent to two 11-in. air compressors, the manipulation which is found good in one case must therefore be equally satisfactory in the other.

Seventh—Because the auxiliary reservoirs of 35-car trains charge so uniformly, it is possible and entirely practicable, to have a standard method of charging empty trains of from 35 to 100 cars, also releasing brakes after applications, with the exception described hereinafter.

Eighth—The quickest method of charging the system as uniformly as possible is to place the handle of automatic brake valve in full release position for one minute, move it to running position for two minutes and follow up with a five-second kick-off, and then leave in running position thereafter. There is no particular reason for the brake valve handle being left in running position two minutes except to draw attention of the engineman to the importance of uniformly charging the train through the feed valve. This provides ample time for the pressure in the brake pipe to equalize. This operation should be timed with his watch.



Annual Convention Held in Denver, May, 1923

Ninth—The best results will be secured in releasing brakes on trains of from 35 to 100 cars after service reductions ranging from 10 to 40 lb., by the following manipulation: Place the handle of the automatic brake valve in full release position for 15 seconds, move to running position for 30 seconds, and then make a three-second kick-off to full release position. An exception to this is made when making 10-lb. reductions on trains of less than 60 cars. In such cases, the brake valve handle should be left in full release position 10 seconds initially, instead of 15 seconds. Reductions of more than 20 lb. were intended to represent cases where the engine is cut off from the train for coal or water.

Discussion

In presenting the paper, Mr. Peck stated that the tests were made with a view to developing the proper charging of trains and use of the release position of the engineer's brake valve on level road and not on mountain grades. He explained that on the Baltimore & Ohio it was not on the heavy grades that the trouble from overheating wheels was encountered, but on level districts. The discussion, however, dealt largely with braking on heavy grades. A number of the members emphasized the importance, in grade work, of restoring brake pipe pressure in the shortest possible time and did not regard with favor any instructions as to the details of brake valve manipulation, since safety depended so largely on the ability of the engineman to exercise his judgment according to circumstances.

P. H. Langan (D. L. & W.) said that an investigation several years ago as the result of many break-in-two's in handling 100-car empty trains, developed the fact that the enginemen were holding the release position for about 12 seconds, going to the running position, then to the release position for the kick-off and back to the running position in a total time less than that required for the run-in of the slack to take place. The adoption of a 30-second release stopped the break-in-two's. After water stops, Mr. Langan advocated holding the brake valve in release position from three to four minutes, then going to running position, followed by a 15-lb. reduction before the kick-off.

In handling trains on grades, Mr. Langan expressed the opinion that safety required the longer period in the charging position, while on the level its use was justified because of the saving in time. He advocated requiring the trainmen to bleed off any sticking brakes which might result, as the train moved passed them. Mr. Langan explained that on the D. L. & W. a release after a full application of the brakes was not permitted on freight trains until the train had stopped. Mr. Peck said that on the Baltimore & Ohio the enginemen were permitted to release the brakes at speeds of about 15 miles an hour or above, which would not permit brakes which stuck following the release and recharging, to be bled off by the trainmen. It was suggested that permitting trainmen to bleed off brakes might result in continuing triple valves in service which ought to be removed for cleaning and repairs. It was also suggested that some means be developed for automatically controlling the use of full release position of the brake valve.

George H. Wood (A. T. & S. F.) described the result of a test in which the recharging of a 100-car train with one and two feed valves was compared. Following a reduction of 5 lb. from 60-lb. brake pipe pressure, the pressure was restored through the feed valves until it reached 64 lb. on the first car and 50 lb. on the last car of the train. With two feed valves this required 11 min. 2 sec., while with one feed valve it required 11 min. 58 sec. W. H. Clegg (Canadian National), said that the use of two feed valves had been found undesirable because it took the control of the train away from the engineman when the brake valve was in lap position, because the two feed valves permitted the operation of the brake with so much greater leakage.

Slow Operating Air Pumps

By the Pittsburgh Air Brake Club
W. W. White, Michigan Central

The first requisite in avoiding slow operating air compressors is to insure that they are properly repaired and thoroughly tested when overhauled in the shop. General repairs should be made only at shops where proper tools and facilities for making repairs are provided and where ample steam pressure and facilities are available for thoroughly testing compressors after they are overhauled.

When cylinders are bushed it should be known that the ports in the bushings line up with the ports in the cylinders and that by-pass grooves are cut in the low pressure steam cylinders of cross compound compressors. Before assembling the cylinders and center piece, it should be determined that the center piece is not distorted so as to bring the cylinders out of line, and after assembling it should be known that they are in proper alignment.

It is important that the bushings in the top head have a good fit their full length; that the reversing valve has a good bearing on its seat in the bushing; that the reversing valve chamber cap is a good fit on the top of the reversing valve bushing; that the main steam valve piston rings and the main steam and air piston rings have a full bearing and are not open at ring ends; that the top head gasket prevents leakage between cylinders and between ports; that there is no restriction in any of the steam and air passages and no leakage around air valves, seats and valve cages.

Having established by the shop test that the above parts are in proper condition and that the compressor will make normal speed, the cause for its slow operation when placed on the locomotive may be looked for outside of the compressor itself. However, if it works properly when first applied to the locomotive but later develops slow operation, it may be due to any one of the following causes: (a) Lack of lubrication; (b) air passages clogged; (c) leakage around air valves or cages; (d) badly worn rings in air cylinders; (e) reversing valve and seat badly cut or worn, and (f) main valve piston rings leaking.

The defects in the air end of the compressor are usually indicated by its reduced capacity at all speeds, or, by the capacity orifice test. If the compressor operates slow after correcting these defects, it is advisable to look elsewhere for the trouble.

Numerous cases of slow operating compressors have been found to be due to defects in the compressor governor.

A compressor bracket out of line has resulted in twisting the compressor and causing it to work slow when bolted in place. This has also resulted in broken lugs and cylinders.

It has been found that in some cases where the air compressor exhaust is piped into the cylinder saddle, the speed of the compressor will be reduced by working the engine hard, but at all other times the compressor operates properly. Sometimes in an effort to improve the steaming qualities of the locomotive, the nozzle opening has been reduced to a point that causes excessive back pressure. In one case this back pressure amounted to 45 lb. per sq. in. In considering such cases it is necessary to bear in mind the margin necessary between maximum air pressure required and the minimum steam pressure for proper operation, and that restricted passages or leakage in the compressor itself may not be manifest while the locomotive is standing, but would cause the compressor to slow down from a light exhaust back pressure resulting from working the locomotive.

Restrictions have been found in the air discharge pipe and in the pipe connecting the main reservoirs, due to dirt and carbonized oil.

If the dry pipe to the steam turret or compressor throttle

breaks off or is very loose, the compressor usually operates slowly and works considerable water. In such cases the speed of the compressor is usually affected by the height of the water in the boiler, with high water the lubrication is washed out of the compressor, and it runs slow, whereas with one-half glass of water or less, the compressor will operate properly. In one instance the dry pipe was so close to the locomotive throttle valve that it was robbed of steam, causing slow operation of the compressor when the locomotive was working hard. The trouble was corrected by re-locating the turret dry pipe.

In another case, when drilling the hole in the turret for the compressor throttle the drill forced a thin piece of brass into the turret, which held on one side. After the locomotive was in service the current of steam swung the piece back over the opening, restricting the flow of steam to the compressor throttle and steam pipe. Another instance of insufficient steam supply was caused by the end of the turret valve breaking off and being carried into the end of the air compressor throttle.

A number of instances have been found where the lubricator air pipe had been improperly connected under the jacket, one such case resulting in steam from the lubricator passing to the air cylinder. In the latter instance the compressor worked properly until steam was turned on the lubricator.

Another cause of slow operating compressors is very high main reservoir pressure resulting from the governor being adjusted in accordance with a defective air gage.

It is necessary to make a study of the conditions surrounding each individual case of slow operation and proceed to locate the cause as indicated by the circumstances.

Discussion

A question was raised in the discussion as to what effect worn rings in the air cylinder would have on the speed of cross-compound pumps. While this condition in the single-stage pump is apt to cause an increase in its speed, the opposite effect seems to be produced in the cross-compound pump. The low pressure pistons of these pumps operate against about 40 lb. initial pressure in the high pressure cylinder and leakage past the rings of the high pressure piston would increase this pressure against the low pressure piston. It was brought out in the discussion, however, that there is considerable difficulty in determining the exact cause of slow operation, when the cause lies in the pump itself, because after the pump has been removed and dismantled, all of the parts, any one of which may have been responsible for the trouble, are restored to good serviceable condition. The consensus of opinion seems to be, however, that a large part of the trouble in the case of the cross-compound pump should be attributed to either worn or broken rings in either or both air cylinders.

Standardization of Repairs

By the St. Louis Air Brake Club

This subject has been brought up for consideration for the reason that there is a general and growing belief that the time has come for the standardization of repairs to air brake apparatus, and particularly that portion of the apparatus pertaining to car equipment. The adoption is recommended at this time of some decisive measure to prevent wrong methods of workmanship and the introduction of "kink devices" for performing the machine operations which can only properly be accomplished by special machines designed for the work to be performed.

When we look over the field of triple valve maintenance and repairs, we find many different devices offered for the purpose of truing up the bore of triple valve cylinders. While we may be impressed with the ingenuity of the ideas that appear in them, ranging all the way from a rotating sand paper block operated by an ordinary carpenter's brace to a series of segmental spring actuated blocks carrying corundum inserts and adapted to expand into the bore of a cylinder by centrifugal force, we cannot help but feel that the necessity for accuracy in the cylinder bore has not been given the consideration the job warrants.

It would seem obvious that the same methods employed for manufacturing these devices should be approximated in making the repairs. To put in practice or attempt to use inferior methods cannot possibly result in anything else than a poor job. The repair of a triple valve is a precision job and if the manufacturer is held down to definite tolerances in order that the valve may properly function over a reasonable period of time, it is just as important in making repairs that the valves be returned to an equal degree of excellence.

There are certain limits within which the average repair shop should keep in conditioning triple valves unless the production is sufficiently large to warrant the expense of the proper tools for the work.

It is fortunate that the test racks catch most of the poor work turned out by poor methods, but ofttimes the standard test rack simply complies with the A.R.A. rules and does not correct the inadequacies of a poorly equipped repair point.

We suggest that the Association formulate a proper procedure and proper tolerances for this work, and that this procedure be incorporated in the recommended practices and that the association endeavor to have this become a part of the A. R. A. rules.

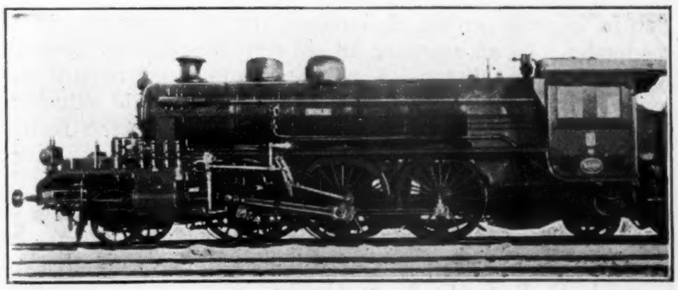
Discussion

Considerable difference of opinion was expressed by the members as to how far it was advisable to repair triple valves at local points and to what extent it was advisable to send the parts to the manufacturers for repairs. C. B. Miles, who presented the paper for the St. Louis Air Brake Club, made it clear that the question was not one of where the repairs should be made, but of establishing tolerances, the observance of which would settle that question according to the circumstances in each particular case.

A motion was adopted calling for the appointment of a committee to investigate and recommend tolerances for triple valve repairs.

Other Papers

Papers were also presented on the following subjects: Air Brake Service Records and Maintenance Costs, by W. H. Clegg, Canadian National; Repair Tests for Feed Valves, by the Manhattan Air Brake Club; The Value of Laundering Air Compressors, by the Central Air Brake Club, and Recommendations for the Maintenance of Air Compressors, by the Dixie Air Brake Club. A talk was also given by George H. Wood, Atchison, Topeka & Santa Fe on The Relation of Train Control to the Air Brake. Mr. Clegg's paper and the paper by the Dixie Air Brake Club will appear next month.



Prairie Type Locomotive With Lentz Poppett Valves for the Oldenburg Railway

Fuel Association to Study the Power Plant

Committee to Recommend Means for Reducing Waste in This Field; Proceedings of Cleveland Meeting

As the result of a paper by R. S. Twogood, describing the methods which have been instrumental in effecting a marked reduction in the amount of fuel consumed at the 125 stationary boiler plants on that system, the International Railway Fuel Association, at its fifteenth annual convention, held at Cleveland, Ohio, May 21 to 24 inclusive, authorized the appointment of a standing committee to formulate and recommend methods of general application to reduce the waste of fuel at such plants.

An abstract of Mr. Twogood's paper as well as several of the other papers and reports presented at the meeting, are given below. Others will appear in later issues.

Report on Fuel Stations

All modern installations are of the overhead storage, self-clearing type and usually with sufficient capacity to receive and store in eight hours the demands for at least 24 hours. Reinforced concrete is the generally accepted material used in the construction of the building itself. Drop spouts are universally used. The housing and details of the actual coal handling mechanism vary with the type and arrangement selected.

In 1914, the committee, after an analysis of the requirements to be met by the coal chute, suggested that the overhead hopper chute of three types would meet any situation. These types were: Gravity chute, with cars elevated by locomotive or stationary power; balanced bucket, in which the coal is dumped into a pit and raised by balanced buckets, and bucket conveyor, with the coal dumped into a pit and raised by a series of small buckets.

From the experience with storage bins designed primarily for capacity rather than for the quality of the discharged coal, the committee recommended that all receptacles for coal should be designed so as to avoid the probability of any clogging in the corners, suggesting that warped surfaces, especially at the openings, be given consideration. Another point made which has been subsequently stressed is the necessity for maintaining the point of delivery of the coal to the bin directly above the opening of the discharge of the fuel to the engine tank.

Recognizing the desirability of some device to measure the coal delivered to the engine, either by weight or bulk, the committee was not in position to recommend any definite plan or arrangement. In 1916 a report was made with illustrations of some of the arrangements in use to accomplish this measuring of the delivered fuel. There have been comparatively few such installations made, however.

The value of mechanically operated chutes is evidently being impressed upon all railroads using coal as locomotive fuel. In some instances, they are replacing comparatively modern gravity chutes, primarily because of the large reduction in the cost per ton of handling the coal from the car to the tender. As an example, an old style shovel chute through which about 16,000 tons of coal were handled per month, was replaced by a mechanical chute with an immediate reduction in the cost per ton for handling of 21 cents. Such a reduction would pay handsomely for the improvements made.

The following were members of the committee: W. E. Dunham, C. & N. W., Chairman; E. E. Barrett, Roberts & Schaefer Co.; C. F. Bledsoe, Ogle Construction Co.; W. S. Burnett; J. C. Flanagan, Fairbanks-Morse Co.; J. W. Krausch, C. B. & Q.; A. A. Meister, S. P.; J. C. Nellegar, Hardy, West Kentucky Coal Co.; L. J. Joffray, I. C.; W. T. Link Belt Co.; H. D. Savage, Combustion Engineering Co.; T. W. Snow, T. W. Snow Construction Co., and E. J. Summers, C. M. & St. P.

Discussion

In the absence of the chairman, W. E. Dunham (C. & N. W.), the report was presented by L. J. Joffray (I. C.). The need for a weighing device, if individual fuel records are to be of any value, was repeatedly brought up in the discussion. A few cases were mentioned where such devices are still in operation at coaling stations, notably the Canadian National and the Chicago Great Western. On the latter road, it was stated that with one exception every coaling station was so equipped. In the opinion of several members, however, the use of such devices at coaling stations is not likely to be effective as a means of checking up the performance of engine crews and getting their support, because they are still charged with the coal burned at terminals for which they are not responsible. It was suggested that what is needed is some simple means of quickly determining the amount of coal actually burned on the road. The use of volume measuring pockets has not yet met with success.

There was considerable difference of opinion as to whether the lowest cost of delivering coal could be obtained with the mechanical or the gravity type of station. On some roads it is claimed that the latter type is cheapest to operate, and that it is more reliable, because in case of failure of the winch for elevating cars up the incline, the operation can be continued by using a locomotive. But attention was called to the fact that gravity stations are confined to two tracks, whereas mechanical handling plants may serve more tracks, and that the question of engine delays should be taken into consideration in comparing the two types. In closing, Mr. Joffray said that the most favorable costs for gravity chutes are obtained from large units, but that in small units they are expensive and are obsolete.

The Other Ten Per Cent

By R. S. Twogood

Assistant Engineer, Southern Pacific Company

About 10 per cent of the total railway fuel consumption is for railway power, heating, shop, roundhouse, and pumping plants, coaling stations, and for other miscellaneous purposes. This 10 per cent amounts to about 17,000,000 tons a year. The percentage of waste of this item is high because very little attention has been given to the proper design and supervision of the average small boiler plant. The experience of the Southern Pacific during the last few years indicates that, as a very conservative figure, 25 per cent of this fuel can be saved by proper design and supervision.

In order to discuss this subject in detail it is necessary to make a general classification of stationary plants:

(a) Large electric generating plants.
(b) Large boiler plants.
(c) Shop boiler plants.
(d) Small heating, power and pumping plants.

Very few plants of Classes (a) and (b) are required by the railroads. Because of the high cost and the importance of operation of these plants, high class engineers and operators are necessary. Usually these plants have the many instruments required to permit the continuous checking of efficiency. A saving of one or two per cent of the fuel is

worth going after. Savings of 10 per cent are hard to find.

The small heating, power, and pumping plants are the most neglected of all plants. Such plants are found everywhere. The percentage of fuel waste is high. There is almost no supervision. The plants never were designed; they were just built. They are difficult to check. For them, standards in design or operation simply do not exist.

As a rule, the smaller the plant the larger the percentage of needless waste. Especially in the railroad business, we are forced to operate a great number of small plants where the fuel waste is known to be very high. There are no standard test codes that can be used economically to continually check these small plants. The engineering profession, in its desire to build the comparatively few plants with high efficiency, has overlooked the tremendous waste of fuel in the thousands of small plants.

About four years ago the Southern Pacific organized a fuel conservation committee. This committee consists of a representative from each engineering department. The needs of each department are, therefore, taken care of without the duplication of equipment.

Our committee has made a great many tests of small plants in connection with our work on standardization. Atomization of liquid fuel, and drafting oil-fired furnaces have led to endless discussion. There are hundreds of oil burners on the market and every burner salesman claims a fuel saving of from 15 to 50 per cent over any other burner. The small boiler plant operator is at the mercy of these salesmen. The Southern Pacific operates about 125 boiler plants. The possible savings or loss due to the use of various burners in a large number of plants makes a study of burners very much worth while. A 150-hp. boiler was therefore equipped for testing. Before many tests had been made it was evident that the drafting was just as important as the burner. Therefore, in all of the tests the burners and drafting have been tested together. In seventy-five tests on the same boiler the net furnace and boiler efficiency has varied from 45.5 to 75.5 per cent. Many factors have been determined and certain burners have been put on the approved list. It is now possible to lay out a furnace with reasonable assurance that the plant will operate as desired.

Steam and air lines underground are soon forgotten. Most insulating material is porous. It is difficult to keep pipe covering dry underground, and wet pipe covering ceases to have much insulating effect. Compressed air is one of the most expensive materials used around the shop. Air lines should be given frequent soap tests. Therefore, except for very special cases, new steam and air lines are being installed above ground. The steam lines are well insulated, and the insulation weatherproofed where installed outdoors.

Fuel oil and water meters are gradually being installed in the larger plants. This permits of frequent evaporation check of plant and operators. Where such meters are installed a simple evaporation test is made at least once per month. These monthly tests are simple, inexpensive, give a frequent check of plant operators and keep the men on the alert to excel the other fellow.

In one plant the fuel saving in July as compared to May was over $11 per day, due to the increase in equivalent evaporation. The meters cost $650 installed. The savings paid for the meters in two months. The water meters have given some trouble; the hot boiler feed water is hard on the meters and they must be calibrated and repaired frequently.

A thorough inspection is made of every plant at least once a year. A division official accompanies the fuel committee during this inspection. The need of repairs or additional equipment is determined, and the work programmed for the year. In order to express the condition of a plant in simple form, and to compare one plant with another, a rating form has been worked out. To express the condition of a plant as "Excellent," "Good," "Fair," or "Poor" is not enough, because it does not show what must be done to improve the condition. For this rating, therefore, the important details of a boiler plant were listed, and each detail given a weight about in proportion to its importance. It is realized that a good fireman or engineer is an important element in any plant. However, no weight was given for the fireman or engineer because his efficiency is reflected in the details. Any rating must be as mechanical as possible so that a plant would receive about the same rating if made by several independent inspectors.

An analysis of this form shows why a plant rates as it does, and what must be done to raise the rating. Some items can be put up to the engineer for correction, but others are strictly up to the supervisor. Efficient plants are only obtained by the co-operation of all concerned. The rating of a plant is often used as an argument when requesting authority for expenditures.

To increase the incentive for fuel conservation, the ratings of plants are given wide circulation. A list of all plants on the system, showing the rating of each plant, with the highest ratings at the top of the list, is sent to each plant annually. Plants are also grouped by divisions, and averaged so that the standing of divisions can be determined. All plants receiving a rating of 80 or better are classed as Premium Plants and are issued a framed certificate, signed by the committee, showing the rating and the reasons therefor. The results have been very interesting. For the year 1921 there were 10 premium plants, the average rating of the 10 plants being 85.1. For the year 1922 there were 26 premium plants with an average rating of 87. So that there was not only an increase in the number of premiums, but also in the average rating of premiums. The average rating for the System for the year 1921 was 66.72, and for the year 1922 it was 70.24.

A plant may be in perfect mechanical condition; it may have the latest, most efficient equipment; but without a trained operator interested in his job, high efficiency cannot be expected. The education of the operator, then, is without doubt the most important single detail in connection with fuel conservation. Instruction is always given during plant inspections, but it is hard to see more than one of the three operators during a plant inspection. An inspector may adjust dampers, burners, etc., but the fuel that can be saved in two hours is small. The large fuel saving comes when the operator absorbs the instruction given him and continues the saving day after day. A fireman cannot be made in two hours; so continual savings cannot be expected unless the training is consistently followed up. Firemen instructors to stand watch with the regular operators several days at a time, make big reductions in the fuel bill. Personal instruction followed by carefully prepared printed matter will hold the fireman's interest. A loose-leaf instruction book on power plants is now being issued by the committee. It is being sent out a few sheets at a time. In the end it is expected to cover the latest standards in equipment and operation and the fundamentals of steam engineering.

This subject is of great importance to everyone of us, because each one must pay his share of the loss that increases the cost of producing every article requiring power. Small corporations cannot afford to undertake this problem; large corporations cannot afford to overlook it. But they do! It is, therefore, recommended that a standing committee be appointed to study this problem. It might also be advisable to co-operate with the American Society of Mechanical Engineers, so that advantage might be taken of the vast amount of work already completed by that society.

Discussion

On motion, the author's suggestion that a standing committee be appointed to study the problem and recommend methods for effecting fuel economy at railway power plants, was adopted by the association.

Value of Individual Fuel Performance Records

By L. G. Plant
Editor, Railway Review

The object of an individual fuel record is not to account for all the fuel used. That is a function for the auditor, and the fuel supervisor who is more concerned with the manner in which fuel is being accounted for than the manner in which it is actually used is wasting his own time and the company's money. What is desired, and all that can be expected of an individual fuel record, is a correct indication of relative fuel efficiency. To determine the relative fuel efficiency of enginemen and locomotives it is obviously essential to compare their performance under uniform conditions. This calls for a segregation of individual records by runs and locomotive types as well as by class of service. It also calls for elimination from the record of runs made under abnormal conditions. Distinctions in regard to runs and locomotive types are commonly observed by grouping the monthly performance records accordingly, but variations from the average speed and tonnage of each group are not easily accounted for.

Bearing in mind the object of an individual performance record, it may be stated that, in principal, it is better to base this record upon three trips conducted under normal operating conditions than upon 30 trips where unusual operating conditions obscure the real efficiency of the enginemen and locomotives. The elimination of those runs on which unfavorable operating conditions prevail can be made the basis for a very practical individual performance record by determining for each trip, the freight train ton-miles or number of passenger cars handled, the quantity of fuel used, the time between terminals and the fuel consumption per 1,000 freight ton-miles or per passenger car-mile.

Where the performance on all runs is included in the monthly fuel record some effort should be made to equate the individual averages to correspond to uniform operating conditions, since the real importance of these factors is neither understood by enginemen nor generally appreciated by those officers who are expected to make use of these figures. An equated fuel performance record is one in which the effect of unusual variations from the average time and tonnage are neutralized by an equation. It is possible to determine by actual test the effect upon fuel consumption of various reductions in tonnage or increases in the time between terminals and to apply a factor to each individual fuel record.

Experience has shown that men accustomed to handling locomotive fuel can estimate with surprising accuracy the quantity of coal required to fill the locomotive tender upon arrival at a terminal. Where a conscientious effort is made to estimate fuel issues, it is safe to say that the error will seldom exceed 10 per cent. Moreover, the estimated quantity may be either more or less than the exact amount of fuel, and such errors as occur tend to neutralize each other. It is not likely that the quantity of coal issued to the locomotive would be continuously over-estimated, any more than always under-estimated, if an honest and intelligent effort is made to report these quantities correctly.

Local officers should be required to investigate the performance of any engineer whose name appears at or near the foot of the fuel record more than two months in succession. There are but three contributing causes to consider. Either the engine crew is at fault and needs instructive supervision, or the condition of motive power is responsible and in need of repair, or there is some obvious discrimination in the fuel charges. Investigation along these lines will either terminate the deliberate overcharges or lead to the source of an actual fuel loss. It is a mistake to assume that the value of an individual fuel record is confined to its effect upon the enginemen. If full advantage is taken of these records they are of equal, if not greater, benefit to the officers directly responsible for fuel economy.

No treatise on the subject of individual fuel performance records would be complete without quoting Eugene McAuliffe, to the effect that the poorest individual record is better than none at all. What can be done toward making the individual fuel performance record a more sensitive, hence more effective instrument? Let us consider what could be accomplished with a group of "traveling fuel auditors" comprising from four to six young men, one of whom would be in charge of the group. Select an engine district at random, dividing the squad between two adjacent terminals and an intermediate coaling station. The two men stationed at each locomotive terminal would be required to personally inspect every locomotive on arrival and immediately preceding its departure. In each instance the quantity of coal, as well as its general character, would be carefully noted. The condition of the fire upon departure and arrival of locomotives would also be observed, together with other features that bear directly upon fuel efficiency. The time of departure and arrival of each locomotive, as well as extent of delays on road, the tonnage handled, etc., would be ascertained directly from the dispatcher's train sheets. From this information, an individual fuel performance record, complete in almost every essential detail, would be available. It is not suggested that these records be published daily, but that at the end of a two or three weeks' period, at which time the traveling fuel auditors would be dispatched to some other engine district. Not only the duration, but the sequence of visits by this "flying squad" would be unknown except to those directing this work.

It is not so important to know that an engineman is at the top or the foot of the fuel efficiency list, as to know why he is there. A check of locomotive performance, such as suggested, would disclose conditions on any district that would surprise the local fuel supervisor. It would develop facts regarding locomotive maintenance that would make any master mechanic sit up and take notice. It would reveal fuel losses due to poor dispatching and other operating causes that would startle the average superintendent. Enginemen could not question the accuracy of the fuel performance statement compiled in this manner.

This statement would be compiled by the traveling fuel auditors and posted prior to their departure. Upon succeeding visits to this district, the fuel consumption averages determined by a similar check of locomotive performance would be compared with the previous averages. One concrete example of improvement in fuel efficiency on a single district will do more toward establishing the value of a fuel department in the eyes of the management, than all the general averages ever concocted.

Discussion

The trend of the discussion corroborated the author of the paper as to the necessity of having detailed information both as to fuel consumption and operating conditions, if real economy in fuel consumption is to be effected. It was brought out that the various efforts to interest enginemen and firemen on the Southern Pacific in the economical use of fuel could not be carried out without the information furnished by individual fuel records. While the records themselves do not primarily interest the men, it is on the basis of the records that men are selected to represent the railroad at the convention of the association and at bi-monthly fuel committee meetings on the various divisions.

A description of the Chicago Great Western system of checking fuel performance, developed that it was founded on the principle referred to by the author as "equated fuel performance." Potentials determined by road tests have been set up for each class of power and each service. These are shown on the train sheet and on a report compiled daily by the dispatcher each trip is rated by a comparison with the potential for the locomotive and service involved.

Proceedings of Boiler Makers' Association

Report of Papers and Discussions at the Fourteenth Annual Convention Held in Detroit

In the June issue of the *Railway Mechanical Engineer* there was a brief report of the fourteenth annual convention of the Master Boiler Maker's Association, held at Detroit, Mich., May 22 to 25 incl. Some of the more important papers and discussions thereon are given below.

Safe Ends on Superheater Tubes

As regards the life of superheater tubes and the number of safe ends that should be applied before cutting down for a smaller locomotive, it is the consensus of opinion of your committee: That great care should be exercised so that as nearly as possible there will be only one weld on each flue. This can be accomplished by applying a 5-in. safe end for weld No. 1; 6½-in. for No. 2; 7½-in. for No. 3; and 8½-in. for No. 4, thus cutting off each old weld before applying the new safe end. Welds on the front or large part of the flue are not desirable on account of applying units, etc.

We find it is the practice of some roads to weld on the large end after applying the limit of welds on the small end, while the practice of other roads is to apply only one weld before cutting down for a smaller boiler. This would seem to us a very expensive proposition if the locomotives are equipped with superheater tubes of the same length or nearly so.

We are also of the opinion that a safer weld can be obtained on a superheater tube than on a 2½-in. and 2¼-in. tube owing to the difference in the thickness of the metals.

This report was prepared by a committee consisting of J. P. Malley, chairman; H. Howard and Daniel S. Rice.

Discussion

H. Howard, Illinois Central: We will all admit that we cannot determine the life of a flue, definitely, on account of the water. If we have good water, they will last a number of years, and if there is bad water, the life is very short.

Andrew S. Green, Big Four: I do not believe you can put a 5-in. end on there, and the next time put a 6½-in. end, or your tube will be too short for the boiler. If you cut the ragged end off, it will be too short. You have to have more than 1 in. there. I do not think that will work at all. If you put a 5-in. end on there, as you say, and next weld with 6½-in., you must have more metal or the tube grows too short for the boiler. You will have to have 7 in. on there.

A. N. Lucas: I believe that the best method of safe-ending is, after the tubes have made their first run, without any beads, to apply a 5- or 5½-in. piece at the first safe-end, and when it has made the mileage and comes in, you cut the tube again for welding. That is an extra operation that you can do in the fraction of a minute, and then put the next safe-ends on the opposite end and you still have left, when you cut the tube, enough to go into the boiler—about 4 in. of the first safe-end, and that will give you a good safe-end into the front end and avoid any cracking of the tube. The next time the tubes are taken out, having made the mileage, you cut the tubes to the length for welding and cut off the original weld and put on a piece and it again goes into service with only three welds. On every third operation, you lose a weld. We run for 10 or 12 years with only two welds, most of the time, on a tube.

H. J. Wandberg: This report deals with the life of the superheater tube. Now the life of the tube depends somewhat on the number of pieces, and how we apply them. What I would like to know about all this is what the scrapping weight of the superheater tube is?

T. F. Powers: I want to disagree with the report to the extent that I do not believe it is possible, as Mr. Green says, to safe-end superheater tubes or any other kind of tubes, with only a waste of 1½ in. from one safe-end to another. As I understand this report, the first weld is to have 7½ in. or 1 in. waste. Our experience has been that to properly safe-end, and even with the most rigid economy, you have to figure on a waste of at least 3½ in. for each time the safe-end is applied. That is, if you adopt, to start with, the 5-in. safe end. The second safe-end, including the waste of the front end, in cutting off any waste necessary to cut back of the old weld must be 3½ in., and, if it is only 5 in. to start with, that makes 8½ in. I do not believe it is possible to have a variation of only 1 in. between the safe-ends.

T. W. Lowe, Canadian Pacific: We still continue to weld our safe-ends at the smoke box end, and I want to repeat that again, today, where we have the possibility of having a tube that will not carry a safe-end at all.

We do not have any trouble with reference to getting the superheater units to pass by the welds when we do weld on the smoke box end, and by welding on the smoke box end, we continue our standard of swaging at the back end, which is very helpful toward providing sufficient water space next to the back flue sheet.

Detecting Defective Boiler Sheets in the Shop

Our method of inspection of firebox steel in our shops before going to the layout bench is as follows:

Surface Inspection: In making the surface inspection, a close examination is made of both sides of the plates and all edges, and the plates are rejected when the following defects are found to be present:

Blister	Piped	Snakes
Pitted	Scored	If grinding has been done
Slivers	Imbedded scale	Cracked
Seams	Cambered	Wrong dimensions
Burnt	Laminated	Wrong gage
Bricked	Roll marked	Not bearing proper stamping required, i. e., heat numbers, serial numbers, manufacturer's name or initial
Scabby	Bad edges, caused by shearing	
Cinder spots	Crop ends	
Split	Knifed	
Dished		

Material inspectors in inspecting firebox and boiler sheets follow the following procedure, making their tests as listed:

Bend Test: In the case of boiler steel, a test specimen for bend test is cut traverse to the length of the sheet as rolled, at the top of the sheet. This test specimen is then bent cold 180 deg., for material one inch and under, around a mandrel having the same diameter as the thickness of the specimen, and for material one inch and over, around a mandrel having a diameter twice the thickness of the specimen.

In the case of firebox steel, a bend test specimen is cut from each sheet as ordered. The sheet as rolled is cut into the dimensions of the individual firebox sheets ordered, this test specimen being cut longitudinally. Before and after quenching, it must bend cold 180 deg. flat without fracture at the bent portion. The quenching is done at a bright cherry red, in water at 80 deg. to 90 deg. In the case of firebox steel, in addition to the bends before and after

quenching, a nick bend is made on each firebox sheet from one end of the tensile specimen, and this nick bend test must not show laminations exceeding ¼ inch in length, seams, cavities of foreign interposed matter, such as cinder, slag, etc.

Tensile Test, Boiler Steel: One test piece cut longitudinally from each sheet as rolled is pulled in the testing machine and the following determined:

Tensile Strength
Yield Point
Elongation in 8 in.

In making the tensile tests, a check on the gage of the material is made, and also the fracture and edges examined for any defects, such as laminations, etc. To determine that all plates are represented by the test piece, where more than one plate is sheared from a single slab or ingot, each plate is match-marked so that all plates sheared from a single slab or ingot can be identified with the test pieces identifying them.

Firebox Steel: A tensile test specimen cut longitudinally from each sheet as ordered is pulled and the following determined from the test:

Tensile Strength
Yield Point
Reduction of Area
Elongation in 8 in.

In making the tensile tests, a check on the gage of the material is made, and also the fracture and edges examined for any defects, such as laminations, etc.

Chemical Analysis: Drillings are taken from the tensile specimens and submitted to the laboratory for chemical analysis to determine the following:

Carbon
Manganese
Phosphorus
Sulphur
Copper, when specified

Gage: All the plates are checked for gage and our specification states that the thickness of the plates shall not vary more than .010 in. under that ordered, the full dimension being controlled by the weights as specified.

Weight: The plates are weighed and all plates having the same width and thickness must conform to the permissible variation in weights as outlined in specification.

This paper was prepared by a committee consisting of John J. Keogh, chairman; John P. Powers and J. C. Keefe.

Discussion

J. F. Raps, Illinois Central: When a plate is on the bench, there may be a gas pocket found that will not be apparent unless they shear through it. We often place a sheet over the forge and heat it in order to expand the gas to determine whether or not a gas pocket is in it. That, I believe, was the intention of this paper and not to go into the inspection in the mill, but the inspection and testing of the plate after it is turned over to the shop.

J. A. Anderson, Industrial Works: The only system we use, in inspecting boiler plates when they come to the laying out bench, is to give them a thorough inspection with the eye, on both sides, to see that there are no visible defects. If there is any suggestion that there might be something wrong, we put the plate under a magnifying glass, and that will detect any small flaw. The plate is laid out and rolled and after it is rolled, that is the time to find the defects. After it is rolled, we find, sometimes, a small piece will roll out, showing that scale was present. Sometimes we find laminations after rolling. We scarcely ever find any defects before the plate is punched and rolled.

President Lewis: We have found occasionally that after sheets have arrived at the plant, notwithstanding the tests made at the mills, where the sheets have been defective, laminations and blisters in the inspection in the shop, and often by the man who is laying out the work.

John F. Raps: A great many times, in shearing a plate, we run into laminations or we find defects by rolling the plate. Sometimes we find a gas pocket. Again we have put in the sheets and found when they were in service a few weeks, that there was bulging on the sides of the sheet, and then it cracks an eighth of an inch, and there would be a gas pocket or lamination. You may find it necessary to chip it off with the hammer in order to show it up. Now, the intention of these topics is to find out if any member here is following out any system of inspection of these plates, or doing anything before applying them to the boiler, to determine whether there are laminations or gas pockets in them. We all give them visual inspection on the layout bench, but sometimes these things happen after they have been applied. If any one is following out some other system than has been mentioned, such as putting plates over fire and heating them in order to bring out the gas blisters, or any other method of inspection, let us hear about it.

Edward Hunt, Illinois Central: In making center punch marks on the layout bench you will often run into a blister. Sound the plate with a hammer to see the surface defects. Watch the laminations around the edge of plate and take a general view of it. Follow up the plate when it is sheared. Sometimes, you find laminations away from the original edge, after you have cut through it. Close observation is important, watching your surface and the thickness. Sometimes by cutting you can see defects.

Hammer Testing Staybolts

This report embodies the substance of individual reports by the other committeemen as well as information gathered by the chairman from various railroads through the country.

In making hammer tests, size and weight should be left entirely with the inspector. Every inspector and boilermaker has a hobby of his own and wants a hammer just a little different from the other fellow's. For this reason, it should be left somewhat to the inspector, as it is his touch or sound that detects broken staybolts, and not the size or weight of testing hammer.

As to whether staybolts should be hammer tested or under hydrostatic pressure, the Laws, Rules, and Instructions for Inspection and Testing of Locomotive Boilers, promulgated by the Interstate Commerce Commission, must be complied with first.

We believe it practical to hammer test staybolts while the boiler is under hydrostatic or air pressure. However, this cannot be successfully done on monthly inspection in roundhouse, or when engine is undergoing classified repairs. We believe, and recommend that staybolts should be hammer tested while boiler is empty. In the roundhouse, we believe this should be done just as soon as the boiler is emptied of the hot water and while the firebox is somewhat expanded. In back shop, when engine is undergoing classified repairs, the staybolts should be hammer tested and inspected from interior of boiler, and all defective bolts renewed. When repairs to boiler are completed and hydrostatic pressure applied, all staybolts should be hammer tested again while boiler is under pressure.

The report was prepared by a committee consisting of J. A. Holder, chairman; C. F. Petzinger and William G. Bower.

Discussion

Charles P. Patrick, Meadville Machinery Company: I want to say that the committee's report on hammer testing of staybolts is common sense and logical. Each man has his hobby, in regard to hammer testing. He has his sense of touch and he should use it, but I rise to make a motion that this association, since we have had so many broken bolts in combustion chamber engines, those equipped with flexible bolts, particularly, that we go on record that we

hammer test flexible staybolts each time we test the other staybolts.

W. J. Murphy, Pennsylvania System: Mr. President, I think that is the rule now on all railroads, that you test all staybolts when you go into the firebox, hitting all the bolts in the firebox.

H. J. Wandberg, Chicago, Milwaukee and St. Paul: On our railroad, we hammer test all staybolts, whether flexible or not, but we have the end of our flexible staybolts marked with red so that we can distinguish them from the rigid staybolts. I think most railroads are carrying out that practice of testing all staybolts.

A. W. Schelton: On the Frisco System we have no flexible staybolts marked and every bolt is hammer tested once a month—all of them. We are of the opinion that we find almost as many flexible staybolts broken as we do rigid staybolts in our monthly tests. We find those broken bolts by going over them with at least 100 lbs. of steam, and then we cool the engine and go over the rest of the bolts.

Charles P. Patrick, Meadville Machinery Company: I want to make an explanation of my motion. Some railroads make tests on flexible bolts, but the law requires you to test those bolts only once a year under pressure, and so all are not tested. Now, in the company with which I am associated, we test our bolts every month. If any inspector knows that a combustion chamber is equipped with flexible staybolts and that he is not required to test them, he is liable not to do so each month, since the law requires taking off the caps every twenty-four months. We find broken flexible bolts under the hammer test. We find them broken every month. It is only a short time ago that we found four in one engine and four in another under the hammer test. Even if you do not do so usually, if you suspect the bolt is broken, from the hammer test, it will pay to remove the cap.

L. E. Hart, Atlantic Coast Lines: We have a class of engines equipped with flexible staybolts in the combustion chamber, and we hammer test them and find lots of them broken. We hammer test all of the bolts, and whenever we have the expansion stays in front, we find some of them broken.

A. N. Lucas, Oxweld Railroad Service: Is it not a fact that the federal boiler law and rules require us to test all bolts every month? According to the rule, the cap shall be removed every twenty-four months, but does it not say we should test the bolts every month?

E. W. Young, Chicago, Milwaukee and St. Paul: Rule No. 16 states: "Methods of testing flexible staybolts having caps. All flexible staybolts having caps over the outer ends shall have the caps removed at least once every two years and also whenever the United States inspector or the railroad company's inspector considers the removal desirable in order to thoroughly inspect the staybolts. The firebox sheets should be examined carefully at least once a month to detect any bulging or indications of broken staybolts. Each time a hydrostatic test is applied, the hammer test required by rules 21 and 22 shall be made while the boiler is under hydrostatic pressure not less than the allowed working pressure and proper notation of such test made on Form No. 3."

In order to overcome any mistakes we instruct our men, where it says, "Firebox sheets should be examined carefully at least once a month to detect any bulging or indications of broken staybolts," to examine flexible as well as rigid staybolts, and they cannot examine sheets without testing each and every staybolt. They will detect bulging or any other flaws when they examine the sheets carefully, and we instruct them to test all staybolts.

Charles P. Patrick: It is not in the rule to hammer test staybolts.

E. W. Young: No, but to overcome the trouble in the sheet, we must examine the bolts, and there you have the rule.

W. J. Murphy, Pennsylvania System: I have had some little experience in testing staybolts and here is what we have found in testing flexible staybolts. We have a medium sized hammer for testing the ordinary staybolts and about twice the size for testing flexible bolts. We have found that by using a larger hammer we get better results. The question came up as to whether you find flexible bolts broken or not, and I will tell you that you can find them by hammer testing them. Any good inspector will find broken flexible staybolts, but he will get better results with a larger hammer.

R. C. Young, Chicago and North Western: I would like to know if a flexible staybolt, when the boiler is not under pressure, is not in the same condition as other broken staybolts? It is loose, not bent nor separated, and there is not much success from testing flexible staybolts unless you have pressure on the boiler and tension on the bolts, because when there is no pressure in the boiler, it seems to me much the same as when a bolt is broken.

T. W. Lowe, Canadian Pacific: We find in the law, as agreed, that there is nothing in it which tells us that we cannot do something better than what the law suggests. Therefore, on the western line of the Canadian Pacific, where we use the flexible staybolts, in general, we find it very advisable to have water pressure to the extent of 140 lb. at every test, every thirty days' test—shop test or any other kind of test. This is done for the very reason, that you will not find broken flexible bolts otherwise. We have found, from our experience, in applying a test with 140 lb. pressure, that you find a greater number of broken staybolts than you ever expected to find.

Mr. Wallough (Omaha): I believe in this discussion, here today, you will find that the hammer testing of staybolts is very nearly a lost art. We do not have the old-timers on the job that we used to have and you find very few inspectors get on the job and find the flexible, or any other kind of staybolts, that are broken with the hammer test. When a man follows them up, he finds some more. I have done that, myself. I think when it comes down to broken staybolts, flexible staybolts in particular, that we ought to get together and find some other method so that we can determine whether they are broken or not. I understand there is such a move on, now.

H. V. Stevens, Atchison, Topeka and Santa Fe: I would like to ask the convention if they want to go on record to remove the brick furnaces on oil burning engines? There are screw bolts and there are detector holes throughout the bolt, and does this include the matter of hammer testing them every 30 days?

T. F. Powers, Chicago and North Western: I think that is specifically covered in a rule handed down by the Department of Locomotive Inspection. As I remember it, it says when bolts are applied back of the brickwork, having a hole all the way through, they do not have to be hammer tested.

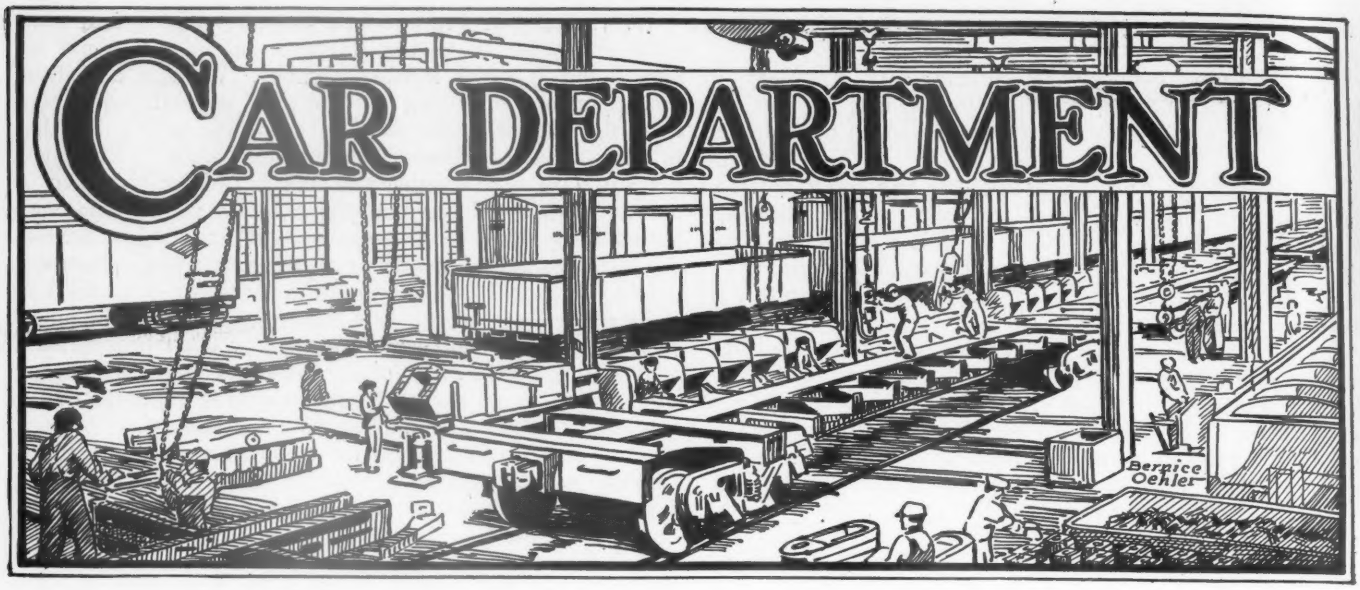
H. V. Stevens: Was not the motion that all screw bolts be hammer tested?

Chairman Lewis: I think this gentleman is justified in this question. Mr. Patrick includes every staybolt in the firebox, and I think that is well taken. We have a number of those bolts, as you suggest, Mr. Stevens, and if we had to hammer test them all, we would have to take out the grates. I think we should change the motion.

Charles P. Patrick: I will change my motion, Mr. President, and make it that we treat all flexible bolts just as we treat rigid bolts.

A rising vote on this motion resulted in its passage.

THE AVERAGE mileage for freight cars per day for the month of January this year on all Class I railroads was 25.8, which exceeds the average for January in any year since these statistics were first published in monthly reports, in 1917. For last year the average was 20.4. For January, 1917, it was 25.3.



Unit System of Repairing Freight Cars

Good Results Secured at the Readville Shops with the Unit, or Station to Station, Method

THE Readville freight car shop of the New York, New Haven & Hartford, in common with other railroad shops throughout the country, was almost completely disorganized July 1, 1922, at the time of the strike. The average pre-strike force (230 men) and monthly output (221 cars) were both practically wiped out. By February, 1923, or in a period of eight months, the freight car shop organization had been rebuilt and the force expanded to 320 men, an increase of 39 per cent; the output had been built up to 362 cars, or an increase of 64 per cent.

A Fine Showing

This relatively greater increase in output than in the number of employees is especially creditable in view of the fact that the new men were largely inexperienced and had to be trained in their work by the limited number of foremen and leaders who remained loyal to the railroad. Readville is primarily a heavy repair shop, 50 per cent of the bad-order cars received at this point being practically rebuilt and 45 per cent given more or less extensive repairs. For example, probably not over 5 per cent of the posts and braces of the cars are saved. Practically all the sheathing and roofing is renewed. Fifty per cent of the posts and braces are cut up and re-used for jack posts and belt rail. New sills, reinforced ends and brake beams are applied; also new shoes for the posts and braces. An increase of 64 per cent in production, as against 39 per cent in force, is a good showing.

Unquestionably, one of the most important contributing factors in the good results accomplished at Readville has been the unit system, or station to station method of repairing freight cars, sponsored by H. C. Oviatt, general mechanical superintendent, and installed and enthusiastically supported by the local shop supervision under the direction of F. E. Ballda, superintendent of shops. Under the operation of this system, the output showed a practically continuous increase from July, 1922, to February, 1923, and has remained at a uniformly high level since that time. Approximately 350 freight cars a month are being turned out and this represents one way in which the New Haven is energetically attempting to improve its car equipment condition.

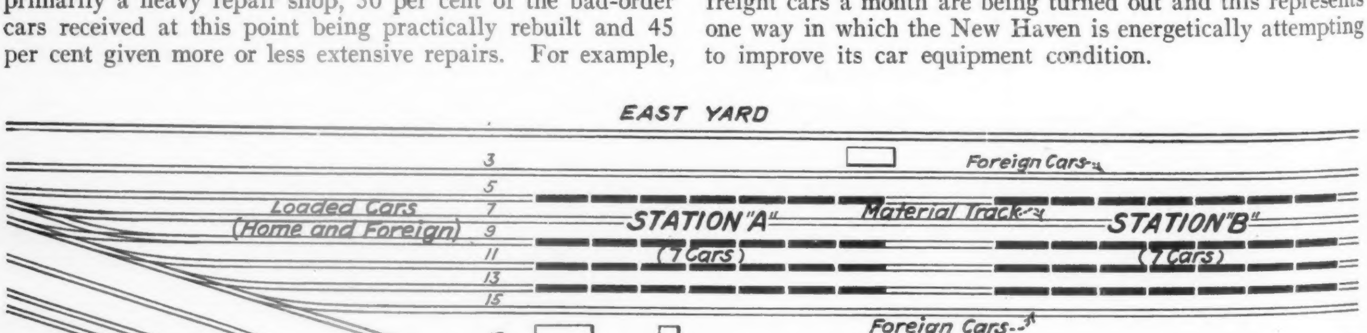


Fig. 2—General Layout of Readville Freight Car Shop and East and West Yards—Positions of Seven-Car Units at Various Stages of Repair Indicated

Fig. 1—The Freight Car Shop Proper Is a Substantial, Well-Lighted Brick Building. (View from East Yard)

A detailed analysis of the freight car output at Readville is given in Table I which shows both the types of cars handled and classes of repair given. Class 1 repairs shown in this table in all cases amount practically to rebuilding and involve not less than 200 man-hours of labor. Normally Class 1 repairs mean anything over 72 man-hours; Class 2 repairs, 36 to 72 man-hours; Class 3 repairs, 20 to 36 hours, and Class 4 repairs, less than 20 man-hours. Referring to the table, it will be noted that by far the great majority of the work is done on box cars, most of which receive Class 1 repairs. The number of Class 3 repairs in February, however, was unusually high (172) and this probably accounts for the record output of 362 cars in a short month.

TABLE I—ANALYSIS OF FREIGHT CAR OUTPUT AT READVILLE SHOP

Kind of repairs	Box	Coal	Flat	Type of car: Ballast	Refrig.	Caboose	Total
November, 1922—							
Class 1.......	93	...	4	...	11	4	112
Class 2.......	13	...	3	...	...	...	16
Class 3.......	46	28	6	...	...	...	80
Class 4.......	14	15	5	...	...	...	34
Total......	166	43	18	...	11	4	242
December, 1922—							
Class 1.......	93	...	5	...	10	8	116
Class 2.......	14	1	2	...	2	...	19
Class 3.......	50	32	8	1	3	...	94
Class 4.......	3	3	1	1	1	...	9
Total......	160	36	16	2	16	8	238
January, 1923—							
Class 1.......	123	...	1	...	5	13	142
Class 2.......	12	5	5	...	...	...	22
Class 3.......	57	47	7	1	1	...	113
Class 4.......	6	6	2	...	...	...	14
Total......	198	58	15	1	6	13	291
February, 1923—							
Class 1.......	148	...	1	...	...	6	155
Class 2.......	21	3	3	2	...	...	29
Class 3.......	90	64	18	...	...	...	172
Class 4.......	3	3	...	...	...	...	6
Total......	262	70	22	2	...	6	362
March, 1923—							
Class 1.......	166	1	2	...	8	6	183
Class 2.......	17	3	4	...	2	...	26
Class 3.......	81	46	7	1	4	1	140
Class 4.......	2	2	...	...	...	...	4
Total......	266	52	13	1	14	7	353
April, 1923—							
Class 1.......	125	1	35	...	2	4	167
Class 2.......	11	9	10	...	1	...	31
Class 3.......	85	66	10	...	1	1	163
Class 4.......	...	...	...	...	...	...	...
Total......	221	76	55	...	4	5	361

TABLE II—SPECIALIZED GANGS ON FREIGHT CAR WORK

Character of work	Number of men
Stripping cars	9
Air brakes	12
Truck and couplers	24
Steel cars and steel underframes	31
Superstructure and roofs	139
Painting	12
Foreign car repairs	73
Laborers	23

How the Unit System Works

The making of similar repairs to a large number of freight cars of the same type probably first suggested the possible economy in the unit system, or station to station method as it

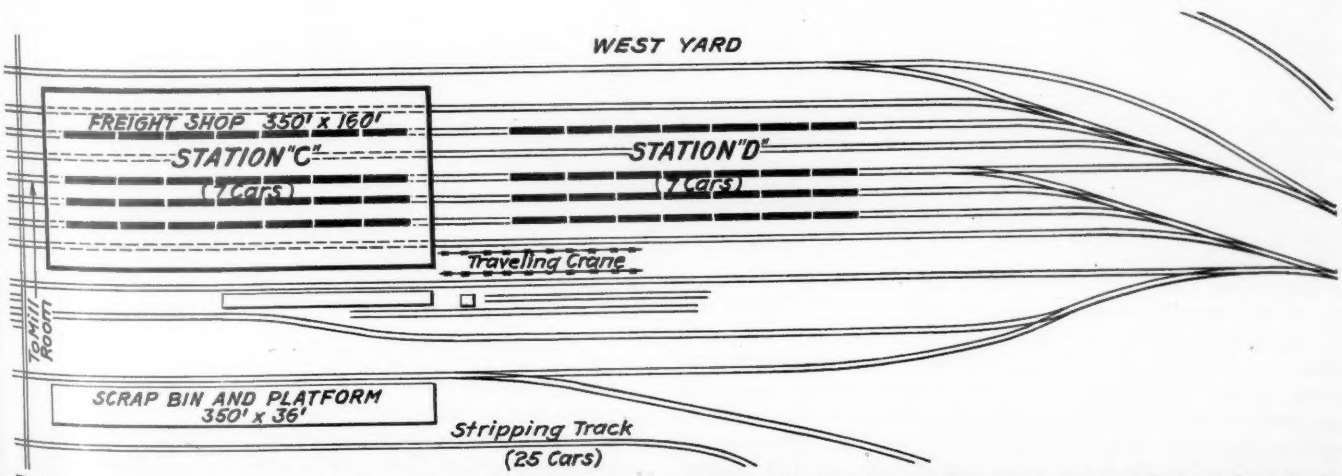


Fig. 2—General Layout of Readville Freight Car Shop and East and West Yards—Positions of Seven-Car Units at Various Stages of Repair Indicated

is sometimes called. Briefly, this system, as employed at Readville, consists of repairing the cars in units of seven, selected so far as possible by serial number, and advancing these units through the various stages of repair from stripping to weighing and stenciling, seven cars at a time. This enables specialized gangs to be used on various phases of the work which was a particularly important factor immediately following the strike because new men could be more quickly trained for special jobs than for all-around car repair work. (Table II shows the specialized gangs and the number of men in each.) In addition to specialization with the resultant speeding-up of the work and reduced cost, the unit system enables material to be handled in quantities directly to the points of application, saving time and labor. The entire operation of the shop is put on a more orderly basis with a favorable effect on output.

The general layout of the freight car shop and the east and west yards at Readville is shown in Fig. 2 with the four stations of repair indicated at "A," "B," "C" and "D." It will be noted that the freight shop, a brick building 160 ft. wide by 350 ft. long, is located between the East and West Yards, forming Station "C" in the order of operations. Tracks 3, 5, 7, 9, 11, 13 and 15 extend through the shop, Track 7 being kept clear for the delivery of material. A transverse track to the millroom, blacksmith shop and machine shop is indicated by the arrow. Track 25, known as the stripping track, extends west of the shop to a large vacant lot which is used as a dump for the burning of wood and debris from wrecked and scrapped cars. Any material having scrap value is readily segregated and moved back to the scrap bin and platform shown in Fig. 2 just north of the shop.

When a string of bad-order cars is received at Readville, it is run out on Track 25 to the dump and the cars stripped with the exception of ladders and grab irons which must be left for safety in movement. An important step taken at this time is the inspection for broken sills and ordering of necessary material in advance. The cars are then classified so far as possible by serial number and moved in units of seven to Station "A" in the east yard. Here the operation of stripping is completed and all repairs are made to trucks, underframes, couplers, etc., as shown in Fig. 3. This work is done by a special gang which, through careful instruction and training, has become expert on this particular phase of the work. It will be noted that only four seven-car units can be accommodated at Station "A," since Track 7 is held open as a material track and Tracks 3 and 15 are devoted to the repair of foreign cars. The section of the east yard between the ladder and Station "A" is used for making light repairs to loaded cars, both home and foreign. The way in which Track 7 is kept clear for handling material is plainly shown in Figs. 1, 3 and 4.

Each seven-car unit, as the work is completed on it at Station "A," is moved to Station "B" in the east yard where the floors are repaired, post and brace shoe pockets applied and all the superstructure repaired or renewed, as shown in Fig. 4. More men are used on repairing superstructure and roofs than on any other branch of the work, the division of men between the different specialized gangs being indicated in Table II.

From Station "B" the respective units are moved to Station "C" which is the freight shop. Here grain slides are repaired, the lining inside and out applied and ladders and safety appliances put up. Sheathing and roofs are applied in the shop; also doors, running boards and one coat of paint. This is to prevent damage from swelling in the event that cars are run out of the shop and exposed to dampness or rain, before final painting. Air brake work, such as cleaning and oiling cylinders, changing triple valves and making necessary brake adjustments, is also done in the shop. The work at Station "C" is illustrated in Fig. 5.

The last movement of the seven-car unit is to Station "D" in the west yard where a final inspection is given the cars, the second coat of paint applied and the cars stenciled and weighed. Air is provided in this yard for spraying the trucks, and if it is stormy, the cars are transferred to Track 15 inside the shop where the painting is done under cover. A string of cars completed and ready for service is shown in Fig. 6.

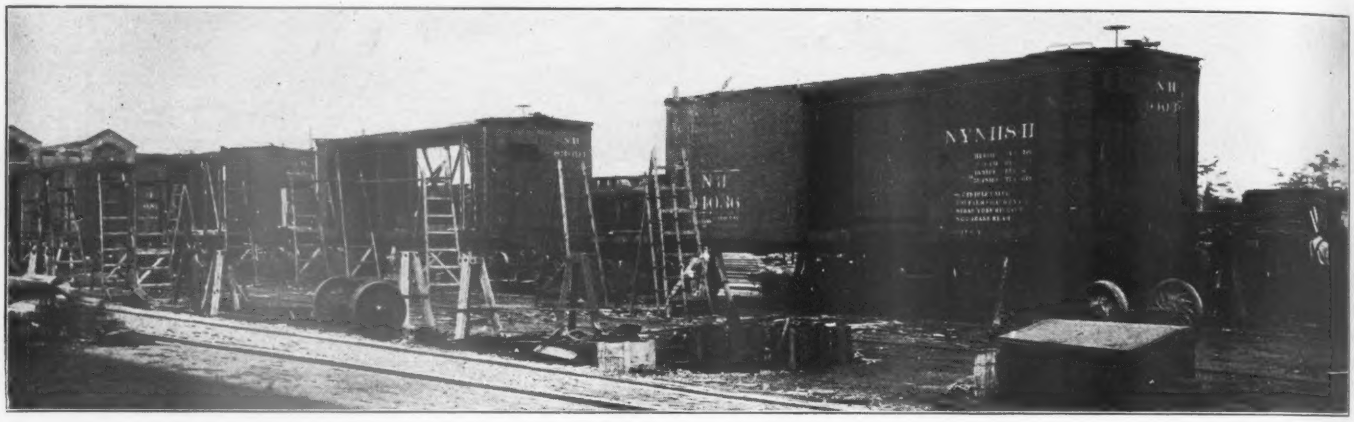


Fig. 3—Cars at Station "A" Receive Repairs to Trucks, Underframes, Couplers, Etc.

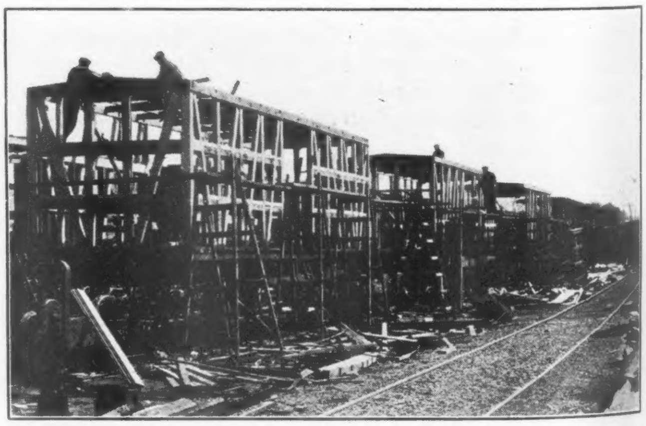


Fig. 4—Superstructure Work Is Done at Station "B"

Economy in Milling and Handling Lumber

An important advantage of the unit system is the saving in milling and handling of lumber used on the cars. The selection of seven-car units, as far as possible of the same series, gives longer runs on the same size stock in the millroom with resulting economy. Running boards are milled in carload lots of 22,000 ft. Posts, braces and sills are milled

with fewer changes in machine set-up and with an important saving in the time of laying out these parts. Sheathing and roofing are not milled at Readville but are bought in 9-ft. and 5-ft. 2-in. lengths, respectively. Both the sheathing and roofing are cut off with a portable power saw after application to freight cars. The bottoms of all posts and braces, also side sills are creosoted, the creosote being applied with a brush.

Lumber, machined to the required size and shape for standard material, is handled on push cars over the standard gage track from the millroom and over material delivery

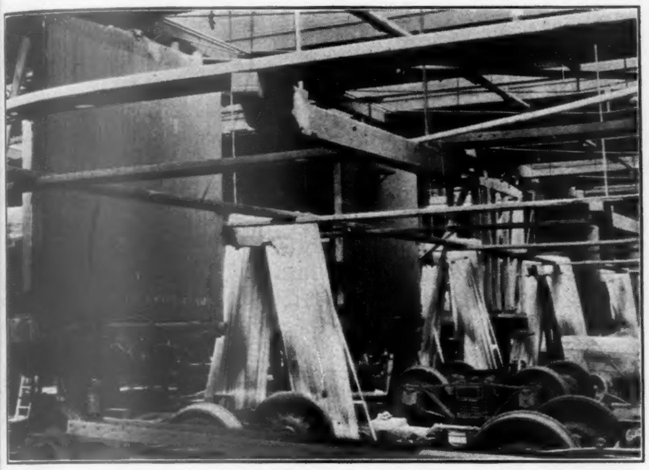


Fig. 5—A Feature of the Work at Station "C" (in the Shop) Is the Orderly Piling of New Sheathing and Roofing Within Easy and Convenient Reach

Track 7, being piled as near as possible to the point of use. In the shop (Fig. 5) material racks are placed on both sides of each car of a size sufficient to hold 154 pieces of sheathing, the average car taking 150 pieces. Roofing racks are large enough to hold roofing for a single car. In general, there is no back movement of this material. It is handled by laborers and left in orderly piles where it can be reached by the repair men with the least possible effort. When a unit of seven cars has been advanced one station, the preceding station is cleaned and material piled in readiness for the next unit and there is no question as to the effect of this orderly handling of material in speeding-up car movement.

In addition to the push cars, a tractor and trailer system is used at Readville to handle material, such as wheels, couplers and other heavy parts, proving a great time and labor-saver. This tractor, illustrated in Fig. 7, is particularly useful in view of the short-turning radius available. The front and back wheels track one another, being connected by crossed tie rods which cause the rear wheels to swivel the same amount and in the opposite direction to the front wheels, greatly decreasing the space required for turning. It is obviously difficult or impossible to back with this arrangement, but any number of trailers within reasonable limits can

Fig. 7—An Effective Storage Battery Tractor and Trailer System Is Used

be loaded at the convenience of the material handling foremen and moved by power to their destination.

Machines in the Freight Car Shop

Adjacent to Track 15 in the shop is a rip saw and gage for rabbeting. In addition, cut-off saws enable considerable reclamation work to be carried on in this end of the shop. Old sheathing, defective at one end, is cut up so that the good portions are re-used. In addition, much hand sawing is eliminated in view of the accessibility of the rip and cutting off saws. Light caboose and refrigerator cars are repaired on Track 3 in the shop building.

In addition to air pressure for the operation of pneumatic

Fig. 6—At Station "D" the Seven-Car Units Receive a Second Coat of Paint; Are Stencilled; and Given a Final Inspection

tools in the east yard, oxygen and acetylene gas pipes are provided so that the cutting and welding torch can be used at any point in the yard. Air is provided in the west yard for paint spraying trucks and for a pneumatic hoist which proves extremely valuable in changing wheels on light repair cars. One end of the car is lifted at a time when the wheels can be readily changed. Track 17 is reserved for this work. Both home and foreign steel cars are repaired at Readville, although most of this work is done at the New Haven's steel car repair shops at Norwood, Mass.

Paint Spraying Pits a Good Investment

The underframes of steel cars, as well as the trucks, are spray painted, this work being usually done at two drop pits recently installed adjacent to the transfer table in the passenger department, as shown in Fig. 8. These pits greatly

Fig. 8—Two Paint Spraying Pits Greatly Facilitates the Painting of Trucks and Underframes

facilitate spray painting the trucks and underframes of cars and have already more than repaid the cost of constructing them. Both air and gas are piped to the pits, the trucks and underframes being painted in a fraction (one-tenth) of the time which would be required with a brush. Possibly one-fifth more paint is used but this paint covers many places which it would be difficult or impossible to reach with a brush. The pits are located between the transfer table and the paint shop and are also used for burning off old floors of passenger cars. This arrangement keeps the odor from burning out of the shop.

Foremen Must Instruct New Men

There are three foremen, two assistants and three leaders in the freight car department at Readville. These men, therefore, have on an average 40 men apiece under their personal direction and the only means so far developed for instructing new men is by personal contact. Foremen's meetings are held once a week for the purpose of studying the progress of the work and ironing out any differences between the various foremen, also getting after material and parts which are delayed.

In conclusion, it may be said that under the unit system of repairing freight cars described, the entire operation of the freight car department at Readville has been put on a more orderly and systematic basis, with a reduction of confusion and lost effort, and a decidedly favorable effect on output, as shown.

Permanent Headboards Between Sections of Pullman Sleepers

FOR some time the Pullman Company has been working on the development of the interior arrangement of its standard sleeping cars with a view to increasing the privacy of the sections when the cars are made up for the day. The first step in this development, which was illustrated in the April issue of the *Railway Mechanical Engineer*, page 224, consisted in the installation of permanent headboards between the sections, extending out from the side of the car flush with the side of the upper deck.

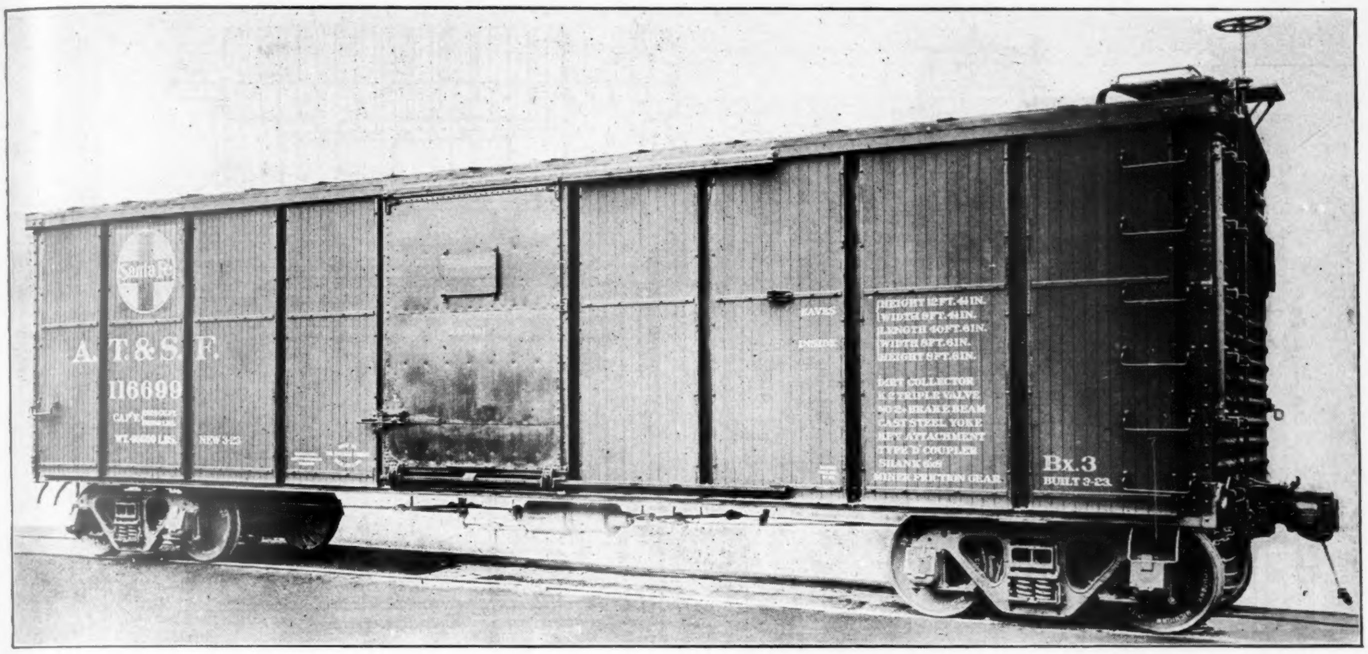
To complete the partition when the berths are made up, a removable section of the headboard is locked in place against the edge of the permanent partition.

The next step in this development is shown in the illustration. In this case the permanent section of the headboard has been extended out farther from the side of the car, and carried across the ceiling so that each pair of sections in effect is in a separate compartment with an arch opening between the compartments. In this construction the headboard is completed for night use by sliding out a section which telescopes inside the permanent partition. This is

New Pullmans Have Permanent Headboards; Telescopic Extensions in Place for Night Use at the Left

automatically locked in place by a latch in the end of the seat which can be released with the berth key.

This type of construction has been applied in a combination 10-section observation car, of which 30 have already been built. Other than in the headboard arrangement, the interior design of the cars does not differ from the standard Pullman sleeping car except that the dome lights, which are located between the sections in the standard cars, are located, one in the center of each pair of sections. There is also a departure from the customary interior finish. The interior steel work below the upper decks is grained and stained to represent Italian walnut, with which is combined upholstery and carpet of blue.



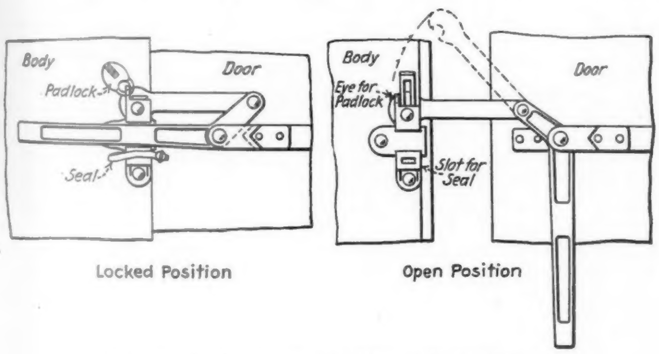
Steel Frame Box Car for Atchison, Topeka & Santa Fe

New Designs of Box Cars for the Santa Fe

Construction Embodies New Arrangement of Side Posts, Underframe Bracing, and Door Opener and Closer

THE Santa Fe has recently placed in service new box cars of two designs—one for general merchandise, the other for furniture or automobile traffic. Of the former class, 3,000 cars have been built or are in process of construction, 1,000 by the Pullman Company, 1,000 by the American Car & Foundry Company and 1,000 by the Standard Steel Car Company; 1,000 cars of the latter class were ordered from the Pullman Company.

The outstanding feature of the construction of these cars is the sectional arrangement of the sheathing, which is fitted



Door Starter and Locking Mechanism

flush between the side post flanges. Where the sheathing extends in an unbroken expanse from door post to corner post, the cumulative effect of shrinkage has been found to result in the opening up of cracks somewhere along the side of the car. The sectional arrangement between the steel frame members localizes this effect so that cracks are unlikely to develop.

The general merchandise cars are designed with center sills of uniform cross section, the body frame being designed to carry a large part of the load. In the case of the automobile cars, however, the size of the door opening is too great to permit with safety this form of construction and therefore the fish-belly type of center sill is used.

The total weight of the merchandise car is 46,000 lb. The automobile car is slightly heavier, its weight being 50,500 lb.

The Underframes

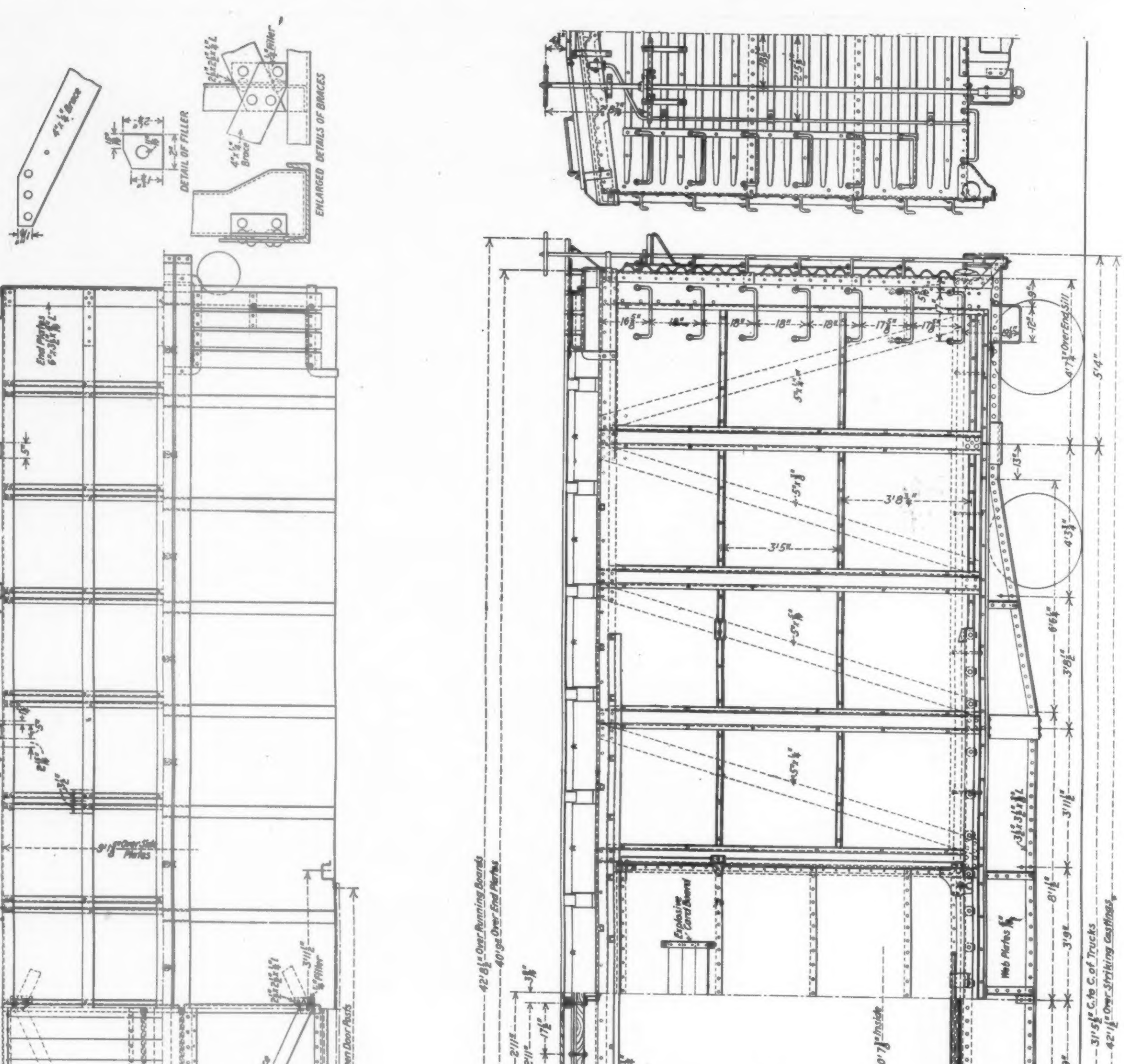
The underframes are of open-hearth steel throughout. The center sill of the general merchandise car consists of two ship channels, reinforced by a 1/4-in. top cover plate; at the bottom two 3 1/2 in. by 3 in. by 3/8 in. angles are riveted to the webs of the channel. These bottom angles extend underneath the center filler and rear draft lug combination casting.

The center sills of the automobile car are of a built-up fish-belly type, consisting of 5/16-in. web plates reinforced at top on the outside by 3 1/2 in. by 3 1/2 in. by 7/16 in. angles and at bottom on outside and inside by 3 1/2 in. by 3 1/2 in. by 3/8 in. angles. The sills are also reinforced on top and connected together by a 1/4-in. cover plate.

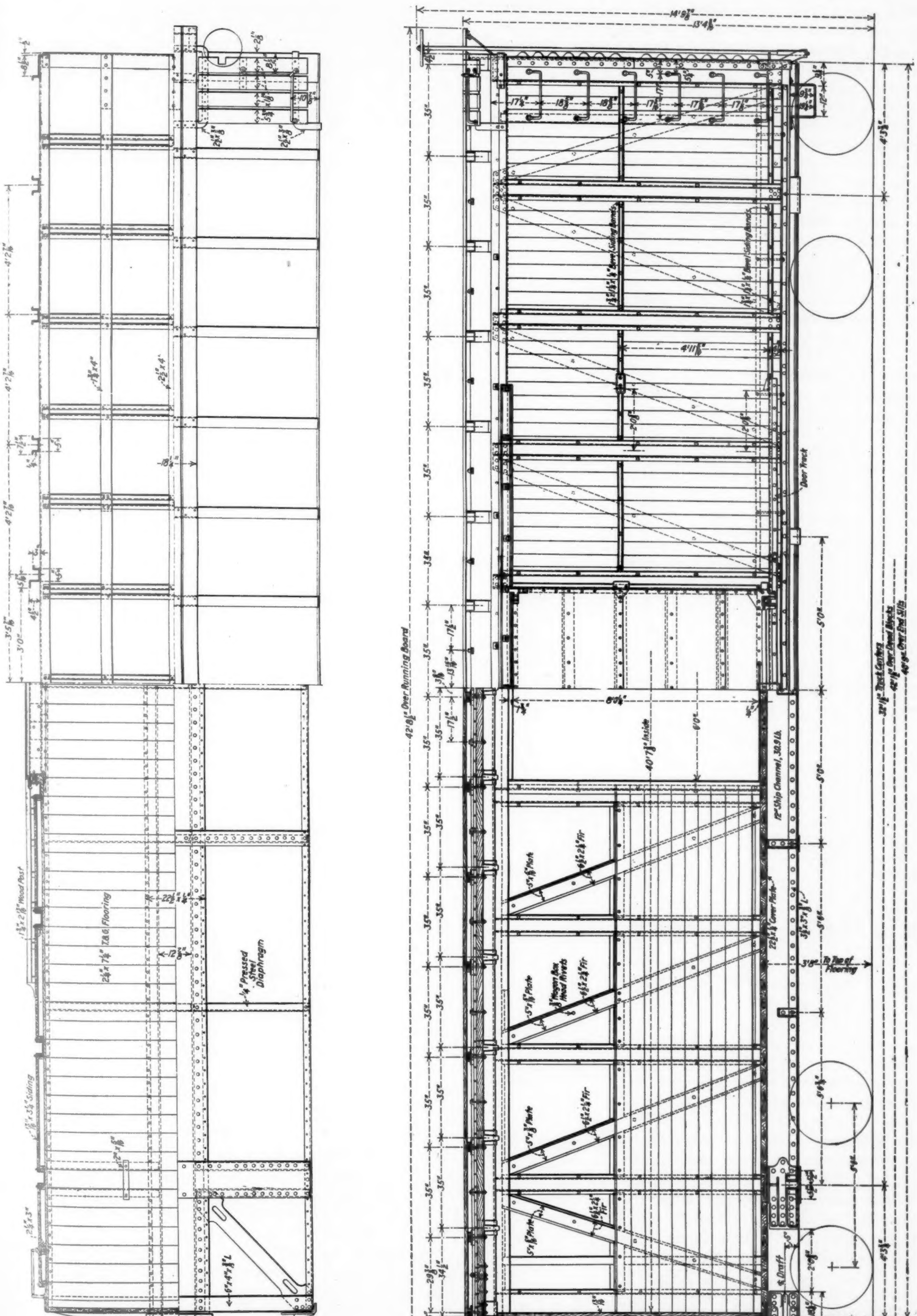
The side sills are of 9-in., 17.5-lb. channels and have angles riveted to the outside faces. The end sills are of 6 in. by 4 in. by 3/8 in. angles and are riveted to the side sills, diagonal braces and center sills. Malleable iron corner-castings and push-pole pockets are riveted to the end sills and side sills.

The body bolsters are of built-up design with cast steel center filler and rear draft lugs combined; the side diaphragms are of 5/16-in. steel plate spaced 7 1/2 in. between webs and reinforced on top and bottom by 14 in. by 5/8 in. cover plates, and with 3/8-in. pressed steel stiffeners between the bolster webs at the side bearings. The body and truck center plates are either drop-forged or of cast steel riveted to the body bolster and truck bolster.

The main crossties are of built-up design, with single 1/4-in. pressed diaphragms at the sides and between the center sills. Those of the general merchandise car are reinforced



General Arrangement of Steel Frame Furniture or Automobile Car for Atchison, Topeka & Santa Fe



General Arrangement of Steel Frame Box Car for Atchison, Topeka & Santa Fe

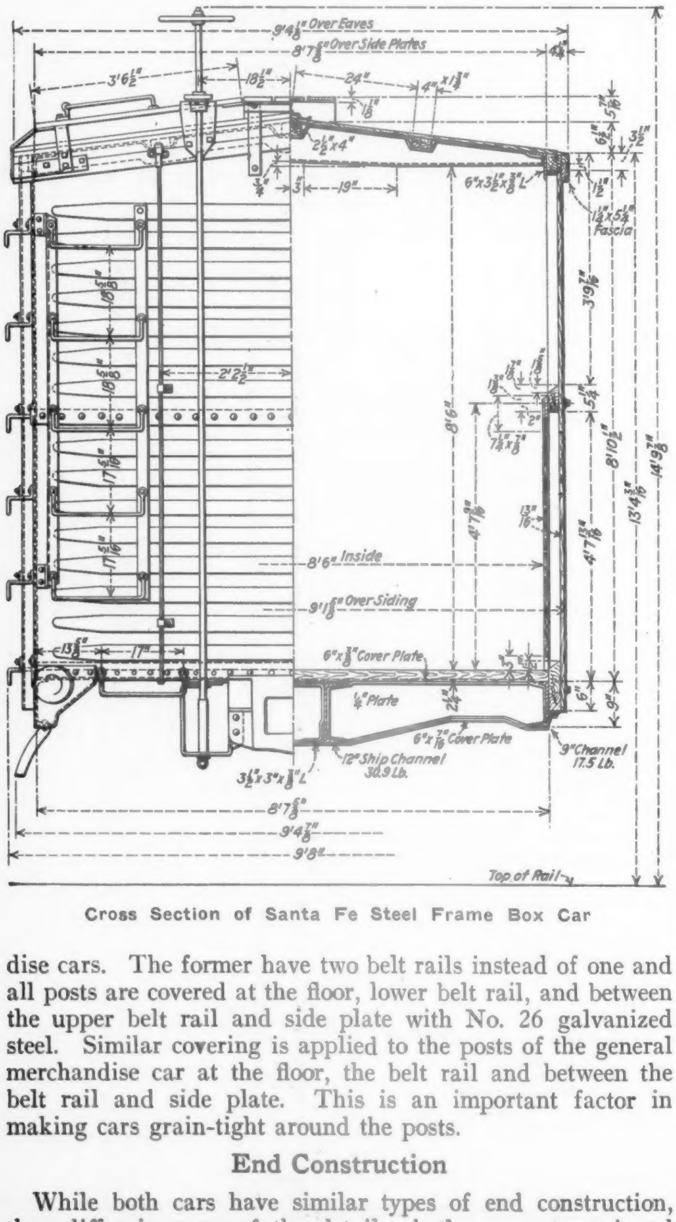
on top by 6-in. by 3/8-in. plate and on the bottom by 6-in. by 7/16-in. plate; those of the automobile cars are reinforced both top and bottom by 8-in. by 5/16-in. cover plates, and these cars are further strengthened at this point by diagonal bracing.

Body Framing

The body framing of both cars is of steel with wood stringers, post fillers, ridge pole, purlines, etc. All posts are cut perfectly square at the bottom ends so as to insure a good fit with the angle riveted to the outside of the side sill channel. To allow for fastening the siding, wood fillers are bolted under the flanges of the posts, and wood stringers, beveled on top, are fitted in between the post fillers and bolted to the side sill and to the supporting angles. Wood fillers are also placed at the tie plates.

There are 13 carlines of 5/32-in. steel plate, pressed to shape, with depressions for the ridgepole and purlines. The ridgepole is beveled on top to the pitch of the roof and riveted on each carline. The purlines are full length pieces, lap-spliced over and riveted to the carlines.

The construction of the body framing of the automobile cars differs only slightly from that of the general merchan-



Cross Section of Santa Fe Steel Frame Box Car

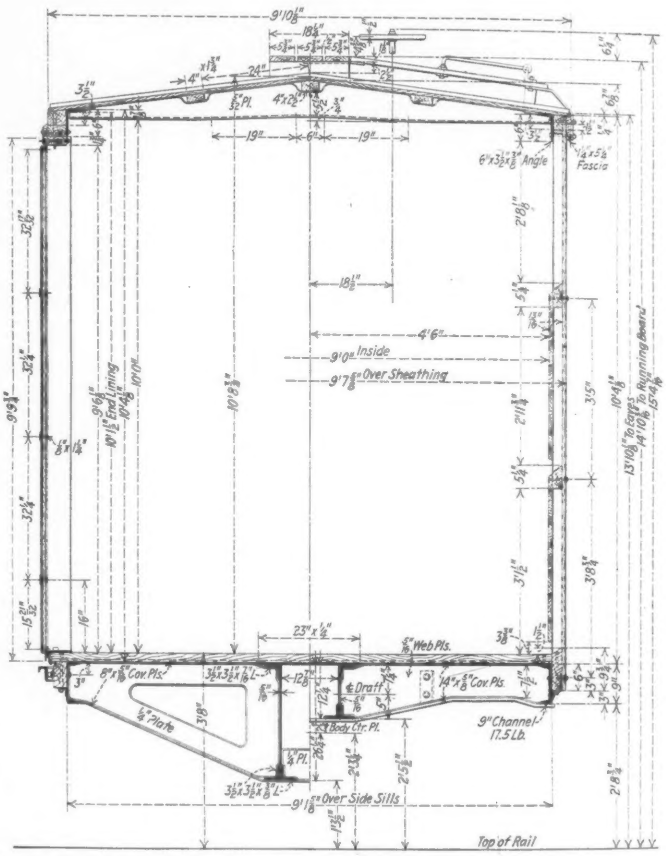
dise cars. The former have two belt rails instead of one and all posts are covered at the floor, lower belt rail, and between the upper belt rail and side plate with No. 26 galvanized steel. Similar covering is applied to the posts of the general merchandise car at the floor, the belt rail and between the belt rail and side plate. This is an important factor in making cars grain-tight around the posts.

End Construction

While both cars have similar types of end construction, they differ in some of the details; both cars are equipped with Murphy steel ends.

The end plates consist of 6 in. by 3½ in. by 5/16 in. open hearth steel angles, pressed to shape. The steel end of the general merchandise car is made in two pieces, of corrugated steel plate, the bottom piece being ¼-in. plate and the top piece 3/16-in. The plates are riveted together horizontally and the side edges are flanged to lap over the corner posts and the end is riveted to the side corner posts, to the end sill angle, and to the end plate.

The steel end of the automobile car is made in three pieces. Each piece is 3/16 in. thick and the riveted seams are horizontal. The end sill, the corner post, and the steel



Cross Section of Santa Fe Steel Frame Furniture or Automobile Car

end are all welded together to close the opening at the top of the side sills.

The lining is tongued and grooved standard section, dressed on both sides, and runs in one piece from the door post to the end of the car.

The siding is V-face fir, dressed on both sides, and tongued and grooved. At each side post the siding boards fit tightly against the flange of the steel post and wood filler, and, after being properly tightened and nailed to the car, are further secured at the side sill and belt rail with open hearth steel straps ¼ in. thick, beveled on two edges.

The Roof

The roof boards are of 13/16 in. by 5¼ in. fir, dressed on both sides, tongued and grooved and applied crosswise of the car. All roof boards are gained on the top side for roof flashing and are sawed at the eaves and ridgepole on a bevel, parallel to the fascia.

The roofs of both classes of cars are Standard Railway Equipment Company's outside flexible metal roof, Type No. 2; the roof sheets, transverse cap, ridge cap and flashing, before galvanizing, are U. S. S. No. 24 gauge. The metal roof is secured to the ridgepole at the corners of the roof sheets by fir saddles and malleable iron center caps, and at

intermediate points by sheet anchors and malleable iron sheet anchor caps.

The eave flashing is nailed to the side fascia, and the end roof sheet and end of ridge cap are nailed to the end fascia The eave flashing is also bolted, a galvanized iron cap being placed over the heads and soldered to the flashing.

All mullions are 1 in. by 2 in. and are nailed under the purlines, at the ridge pole, at side plates and through the roof boards.

The longitudinal running boards are vertical grain fir 1⅛ in. by 5¾ in.; the total width is 18¼ in. The boards are surfaced on one side and two edges and secured to the saddles with flat-head wood screws. The latitudinal running boards, which are of the same grade and size of material as the longitudinal running boards, are held together and secured to the car by steel straps bolted to the car.

The side fascia is of 1¼ in. by 5¼ in. fir, at each side of door head and 1¼ in. by 3¼ in. under the door hood. The fascia is beveled on top to the pitch of roof, rabbeted at the lower outside edge and securely nailed to the car. The end fascia—1¼ in. by 5¼ in. fir—is shaped on top to pitch of roof and bolted to the end of car.

The Car Doors

The side doors are of unusually sturdy construction into which both wood and steel enter. Single doors are used on the general merchandise cars and double doors on the automobile cars, center door-steps being provided for the latter.

The door frames consist of Z-section, steel bars and the corners are mitered; the top corners have malleable iron gussets, which extend above the outside face of the Z-bar sections and are formed to extend over the horizontal projection of the door hood section. The part of the mitered Z-bar not covered directly by the gussets is welded. The bottom corners of the doors are connected by the door-roller housing casting.

The outside of the door is 1/16-in. open hearth steel; the inside consists of fir strips riveted to the 1/16-in. plate and Z-bars. The doors are of the bottom-hung type rollers, housings and track being furnished by the Camel Company.

The door opening of the merchandise car is 6 ft. 0 in. wide by 8 ft. 0½ in. high; that of the automobile car is 10 ft. 0⅜ in. by 9 ft. 6⅛ in. clear with both doors open. With the smaller door closed, the opening is 6 ft. 0⅜ in. by 9 ft. 6⅛ in.

The door locking arrangement, door starter and door open fastener deserve mention. This device was designed by the railroad and consists of a malleable iron handle and arm which are fastened to the door, the arm being so designed as to engage a bracket fastened to the door posts. The method of engagement provides for closing and opening the door, and for locking or sealing it. The starting handle serves as the door hasp and is provided with two sealing positions, one with the door closed tight and the other with the door opened eight inches for ventilation.

The Trucks

The same design of truck is used under both types of cars. The principal features are Andrews cast steel side frames and cast steel bolsters with lateral motion caps cast integral with the bolster. The journals are 5 in. by 9 in. and the weight of a single truck is 7,740 lb.

Other Appliances

The deadlocks are of cast steel with the coupler carrier-iron cast integral with the dealock and provided with a wearing plate for the coupler. The draft gear is Miner Friction Type A-18-S and the A. R. A. Standard, Type "D" coupler with 6 in. by 8 in. shank and 1⅝ in. by 6⅛ in. key slot, is used. The coupler yoke is cast steel.

The uncoupling device is the "Imperial" type. The brake rigging is the Westinghouse Schedule K. C. 1012 with K-2 triple valve, centrifugal dirt collector, 10-20 retaining valve, duplex spring loaded; "Creco" brake beams are used and all lever carrier irons, fulcrums, etc., are secured with rivets. The retaining valve is located on the end fascia. All piping for air brakes is of wrought iron and the trainpipe has a 10-in. nipple of extra heavy pipe at each end of car.

Each automobile car is equipped with 24 hoisting links. These are made from ⅝-in. diameter steel chain, welded into cast steel brackets, which are riveted to the inside face of the vertical flanges of the side plate angles.

Painting

Special provision for preventing the corrosion of metal parts has been made in the method of painting both types of cars. All parts coming in contact on trucks, underframe, and framing, which could not be painted after assembly, have been given a good coat of Lucas car roof cement before being put together. After assembly and before applying any of the wood superstructure, the entire underframe, posts, ties, steel ends and carlines were coated with the Lucas cement. A heavy coat of this same material was also applied to the top side of the outside metal roof, and the crack at the ends of the floor boards was sealed by applying the cement to the inside face of the side sill stringer, inside face of the posts for a height of 2¼ in., and to the top of the side sill flange. Wooden parts were painted all over before application and again after being placed in position. The entire trucks received two coats of carbon paint.

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Missing Brake Rigging Removed from Passenger Car to Permit Safe Operation

In March, 1921, the Atchison, Topeka & Santa Fe rendered a bill for car repairs against the American Railway Express Company which contained charges for the replacement of a missing brake beam, brake lever, bottom brake rod and slack lever guide, together with the necessary bolts and cotters, and a broken safety hanger, to which the express company took exception. In addition to the brake rigging parts, the bill contained a charge for various pipe repairs made to the car on account of a broken branch pipe, for which the Santa Fe furnished a refund. The express company claimed that the character of the damage indicated it was not due to ordinary service, that the missing brake evidently had been torn off due to derailment, running over some obstruction, or had been removed from the car on account of the failure of some item necessitating its removal to safely operate the car into the terminal. Furthermore, the price of $10.02 charged for the renewal of the Diamond special brake beam, it was claimed, does not represent the actual cost of the item less the average credit allowance. After considerable correspondence, the Santa Fe advised that a thorough investigation of the matter had determined that the car was not derailed, that the conductor who handled it on November 11, 1920, removed the material after a hanger pin failure and a broken safety hanger had dropped one end of the beam on the ground. The express company contended that it was not responsible to the railroad for applying new material where the old material in good con-

dition had been removed and retained by the railroad. The railroad contended that the provisions of Rule 95, paragraph 2, referring to missing brake beams and connections, was revised, effective October 1, 1918, for the purpose of taking care of just such conditions as found in this case and that Rule 101 was revised at the same time by the addition of items 171 to 174, inclusive, which provide an "average credit" price for "defective or missing" beams for the same purpose. Applying the same average credit price obtaining for the No. 2 brake beam, based on 34 per cent of the value new, the credit for the Diamond special passenger car beam, including shoes, would leave a net charge of $10.16. The railroad submitted that whether the defective material was left on the line did not enter into the case since the damage was not caused by any agency defined in Rule 8, as delivering line defects.

The Arbitration Committee decided that: "The missing material in question is owner's responsibility. Bill of the Atchison, Topeka & Santa Fe Railway is sustained."—*Case No.* 1256, *American Railway Express Company vs. Atchison, Topeka & Santa Fe.*

Responsibility for Missing Parts—Passenger Rule 7

During February, 1921, the American Railway Express Company rendered several bills against the Boston & Maine for applying bull bars to two of its passenger express cars, to fit them for the transportation of horses. These cars are listed in the Railway Equipment Register as horse cars and were furnished to the express company by railroads other than the owner, for loading horses. The express company maintained that the transportation of horses in these cars is impossible without the missing appliances to separate the animals. It further maintained that the bills cover only the actual invoice price for the material used with nothing added for the labor. The Boston & Maine set forth that the cars, which were first loaded by the express company with general merchandise for the West, are equipped with brackets for the use of metal bull bars and that when loaded with horses at Chicago wood substitutes were applied in place of the regular metal bars. The owner refused to pay the bill on the ground that the cars moved off its line in general merchandise service, and that it did not participate in the revenue movement of the live stock loading.

The Arbitration Committee decided that: "In view of Rule 7, section (d) for passenger equipment cars, the car owner is responsible for the missing details referred to. Therefore, bill of the American Railway Express Company is sustained."—*Case No. 1247, American Railway Express Company vs. Boston & Maine.*

Scope of 60-Day Limit in Rule 91

Bills rendered by the Chicago, Rock Island & Pacific against the New York Central, contained charges to which exceptions were taken by the latter road within 60 days from the date the bills were passed for payment. The Rock Island replied to the letter of exception about one month after its receipt, but did not satisfy the New York Central. The latter road again took the matter up with the Rock Island, but not until after a lapse of considerably more than 60 days following the Rock Island's reply. The Rock Island refused to handle the matter further, claiming that this delay in again bringing the matter up was a violation of the 60-day limit in Rule 91, which should apply to the second letter of exception as well as to the first, if the billing road is not to be required to keep its files open indefinitely. The New York Central contended that inasmuch as the exceptions were originally taken within the 60-day limit, the Rock Island should not be relieved of making settlement for the incorrect charges because of any subsequent laxity in handling the correspondence.

The Arbitration Committee in its decision stated that: "Rule 91 does not provide a time limit for further correspondence based on original exceptions. Therefore, the Chicago, Rock Island & Pacific should handle these exceptions to proper conclusion. It is important that all such correspondence be handled without delay."—*Case No. 1249, New York Central vs. Chicago, Rock Island & Pacific.*

What Constitutes Acceptance of Cars under Interchange Rules?

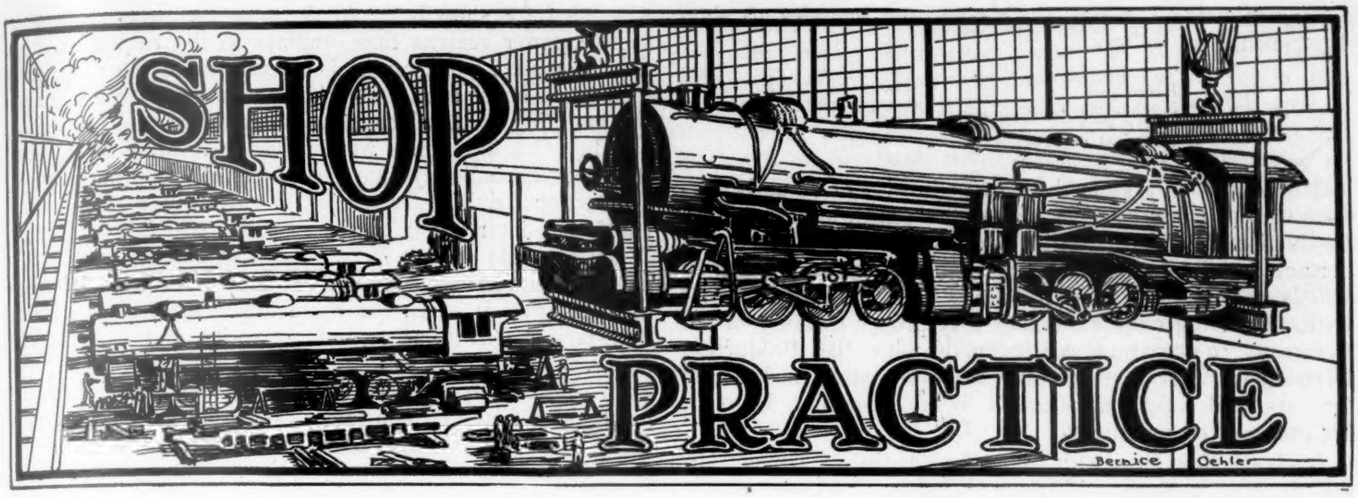
On the morning of August 12, 1921, the Atchison, Topeka & Santa Fe, acting for the St. Louis-San Francisco, placed Wabash car No. 20210, loaded with cotton, on the interchange tracks at Dallas, Tex., to be delivered to the Missouri, Kansas & Texas. At 7.15 a. m. the car was inspected by an inspector for the Dallas Car Interchange Bureau, and no exceptions taken to its condition. The interchange report covering the movement of this car from the St. Louis-San Francisco to the Missouri, Kansas & Texas was signed by B. A. Waldo, interchange inspector and showed the car to have been delivered at 7.15 a. m. At about 11.00 a. m. the car was damaged by fire. Later in the day the waybill was offered to the Missouri, Kansas & Texas, but its agent refused to accept it. The chief interchange inspector ruled that, inasmuch as the waybill had not accompanied or preceded the car, in accordance with car service rules it was still in the possession of the St. Louis-San Francisco railway. On August 31, an interchange report was made showing car delivered back to the St. Louis-San Francisco at 4.00 p. m., August 12. This report carried the notation, "Please add to interchange of August 12, 1921." The St. Louis-San Francisco claims that inasmuch as the car had been accepted and the interchange signed by duly authorized representatives, the delivery of the car had been made and the M. K. & T. was responsible.

The Arbitration Committee decided the case as follows: "The acceptance of cars under the interchange rules is not predicated upon the delivery of waybills to receiving line. Car was inspected on the designated interchange by the inspector of the receiving line and no exceptions taken to its condition. Under the interchange rules, the car was at time of fire in possession of the receiving line. The receiving line is responsible for the damage to the car."—*Case No.* 1254, *St. Louis-San Francisco vs. Missouri, Kansas & Texas.*

Intent of Rule 60 Where Broken Parts of Triple Valve Are Renewed

A K-1 triple valve was removed from Grand Trunk car No. 11411 by the Central Vermont and a new K-1 triple was applied and the owner charged for broken parts in the triple removed. The brakes were not cleaned at the time because they had been cleaned only a short time before. Exception was taken by the owner to the charge of $2.21 made for this material. The Central Vermont contended that the interpretation after Rule 60 does not prohibit this charge as it does not seem that the rule would make it compulsory needlessly to clean brakes and bill the owners for this work. The Grand Trunk claimed that the rules provide no charge for repairs to a triple valve other than mentioned in Item 29, Rule 111, which is based on cleaning of both triple valve and cylinder and failure to comply with the full requirements of this rule would prohibit the rendering of any bill.

The Arbitration Committee decided as follows: "It is the intent of Rule 60 that charges for repairing triple valve or brake cylinder is permissible only when regular annual repairs are made in accordance with the standard practice of the association. The charge should be withdrawn."—*Case No.* 1253, *Central Vermont vs. Grand Trunk, Western Lines.*



Locomotive Scheduling at the Silvis Shops

Part 2

New System of Locomotive Scheduling Now Being Installed at the Silvis Shops of the C. R. I. & P.

By L. C. Bowes* G. E. Sandstrom†, and H. K. Robinson‡

HAVING in mind the three basic divisions, as explained in the July issue, it is desired in this article to bring out more in detail the complete cycle of centralized control of the activities in the back shop.

Organization for Centralized Production Control

Under the plan of organization existent in railroad back shops for many years, each department head was burdened with an entire set of activities which consisted of planning, ordering material, scheduling inspection and processing. Under such a plan of organization it is obvious that great difficulty is experienced in co-relating the separate activities of the various departments to provide for the most efficient sequence of both major and detail operations providing for a continuous and uniform flow of production. By careful and unbiased analysis it has been fully demonstrated that it is most unreasonable to expect one department to visualize the current or probable activities of all other inter-related departments.

It was also found that by reason of each department being burdened with the responsibility of all activities, there resulted a considerable overlapping of the two great divisions of any organization, *i.e.* functions (planning, ordering, and routing material, scheduling and dispatching of work, processing and inspection) and routine (that organizational machinery for carrying on these functions).

Therefore, the thought presents itself of the possibility of visualizing and providing for complete production control in the most efficient and effective manner. As a result, the plan adopted is one based on the proper grouping of unit activities under several centralized organizations. It may be well at this time to state that, in addition to the advantages gained through centralized control over production in the potential increase of output, there is the additional and very vital advantage of securing and controlling accurate cost data and operating statistics, which necessitated the need of a cost accounting division, the functions and routine of which will be fully described in a later article in this series.

In sequence of their relative importance and performance, we have the following major divisions: 1 Production, 2 Processing, 3 Inspection, 4 Plant, 5 Personnel, 6 Cost Accounting.

These are all separate and distinct divisions with complete authority within themselves, each reporting directly to the administrative office of the shop.

Function of Production, Processing and Inspection

The following is a brief description of the functions of the various divisions as outlined.

1—*Production Division*: The three main departments of this division, together with their respective functions, are:

A—Technical

Operation and material analysis
Time studies
Wage payments
Capacity
Operating statistics
Shop layout
Equipment analysis
Tool record
Equipment record

B—Schedule

Schedule
Routing
Dispatch
Material requisitions
Production cards
Time checkers and dispatchers
Material delivery
Trucking

C—Material

Analysis of
  Future schedule
  Locomotive Work Report
  Inspection reports

Record of:
  Order
  Reserve
  Disburse

*Production Engineer, C. R. I. & P.
†Industrial Engineer, Roberts-Pettijohn-Wood Corporation.
‡Special Accountant, C. R. I. & P.

2—*Processing Division*: This division includes all shop departments, as follows:

Tool department
Forge shop
Machine shop
Boiler shop
Electrical department
Stripping and erecting department

and functions only as to the responsibilities of actually performing the work as reflected on the schedules created by Production Division. This responsibility is a very important one, each general foreman and his aides being held strictly accountable for discipline in their respective departments, watching closely methods and proper training of the workmen, co-operating continuously with the Production Division in order that schedule dates be maintained. Also they are held strictly accountable to the Inspection Division for accuracy of production.

3—*Inspection Division*: The three main departments of this division, together with their respective functions, are:

A—RECEIVING

Locomotives
Back shop
Material

B—PROCESSING

Material and operations in process
Locomotives in back shop

C—FINISH

Locomotives in back shop
Material and operations

4—*Plant Division*: The functions of this division are:

A—Power house
 Boiler room
 Engine room
 Maintenance
B—Maintenance
 Millwright
 Electrician
C—Watch service

5—*Personnel Division*: The functions of this division are:

Employment records
Emergency and first aid
Welfare and safety first

6—*Cost Accounting*: As stated before, the functions and routine of this division will appear in a later article.

Based on the foregoing functions and by reason of intense and centralized routine, as outlined in the following, it may be well to state that the ultimate goal of this endeavor is to demonstrate the possibility of doubling the output of locomotives in the back shop, with no appreciable increase in man-hours.

Routine of Production, Processing and Inspection

The proper basis for starting the consideration of the routine of production control is with the origination of the locomotive work report. This pre-supposes complete and definite analysis and the reporting thereof of all necessary work to be performed on the locomotive assigned to the shop, as lies within the capabilities of enginehouse and line organization, and such defects as may be revealed by effective enginehouse and line inspection.

The completeness of this locomotive work report is most vital in that it serves a double purpose, first, that of providing prior data upon which to schedule the purchase of material; second, that of providing prior data for scheduling the locomotive in its proper course of overhauling in the back shop in its relation to the other activities, thereby providing a very definite means of maintaining the maximum in balance loading of all production facilities.

In addition to the necessity for completeness and accuracy of the locomotive work report, it was found necessary and possible to have these reports in the office of the superintendent of motive power at the same time that shopping lists are received from the line, which is at least 45 days in advance of the month in which the locomotives in question are scheduled for shopping. At the time the superintendent of motive power assigns these engines to the respective shops, the locomotive work report is released with the assignment. Too much stress cannot be laid upon the effective routine of the handling of this locomotive work report.

When this locomotive work report is received at the shop, it passes immediately into the Material Department of the Production Division, where it is carefully analyzed as to itself and its relation to the material schedule in general. When the data on this locomotive work report, by reason of its analysis, has found its proper place in the material schedule, authority is given the Store Department to provide for necessary material, as regards quantity and time requirements.

In conjunction with the analysis by the Material Department, the Schedule Department also analyzes the locomotive work report, and by considering the material schedule and the work schedule as reflected on the Master Schedule Board, assigns the locomotive in question to its proper place on the Master Schedule. The important point to be brought out in this connection is that all of the above routine is carried on prior to the actual arrival of the locomotive at the shop.

Before even attempting to schedule, and the consequent processing and inspection, it is imperative that there be complete, detailed and accurate technical data—originated and established by the Technical Department of the Production Division. This technical data incorporates the basic and most vital operating analysis which is the back bone of all shop activities.

Contrary to the general supposition heretofore that the secret of economical increase in production was the perfection of mechanical details of operation, it was found that the real controlling factor was the analysis and possible perfection of these activities reflected in—

1—Shop layout
2—Shop capacities (vs. desired output)
3—Operation analysis
 a—Times
 b—Compensation
 c—Sequence of operations
 d—Routing of parts
 e—Man-hour analysis
 f—Unit operations
 g—Tool analysis
4—Equipment analysis and record
5—Tool record
6—Material delivery system
7—Processing analysis
8—Operating statistics

which is the responsibility of the Technical Department of the Production Division. Having this information available in record form, it is now possible to proceed with an effective and production schedule.

When the locomotive is actually received at the shop, the Receiving Department of the Inspection Division, makes their inspection of the locomotive, immediately rendering a report jointly to Material and Schedule Departments of the Production Division, who then make the necessary analysis with respect to material and work schedules.

Referring to the former article in the July issue, it will be noted that supporting the master schedule boards, there are the necessary sectional or departmental boards located at proper points in the shop. With particular reference to dispatch booths, the dispatch boards therein, and booth dispatchers, these men are now ready to originate production or work order cards based on the aforementioned sectional or departmental schedule boards. They will also be in a position to originate the material requisitions calling for delivery of necessary material from the store house to the proper point in the shop at the proper time. All cards, both production and material, are originated at least a day in advance of the schedule needs.

The point of actual production is now arrived at and the workmen will present themselves at their respective booths, call their production center number and receive from the

booth dispatcher their production cards. The dispatcher, before releasing these cards to the workmen, will enter the "Start Time" and will supply the workmen with all necessary blue prints, specifications and standard practices to enable them to complete the work without delay. The workmen, before leaving the dispatch booth, will surrender the card for the work they have completed, together with the blue prints, specifications and standard practices for the work they have performed. The dispatcher will then stamp "Stop Time" on the cards surrendered.

The dispatcher will also check with the Process Department of the Inspection Division and enter on cards the quantities produced by the workmen.

The general foremen and their aides will refer continuously to the sectional or departmental boards in their departments and also the dispatch boards—as the very important responsibility of performance now lies with them—in order that schedule dates may be met in all cases. They also work in conjunction with, and are responsible to the Processing Department of the Inspection Division. When operations on locomotives have been completed the work will be inspected by the Finish Department of the Inspection Division, whose responsibility will be the transfer to the transportation department of 100 per cent locomotives.

[The forthcoming article will deal with details regarding the organization, functions and routine provided for the Cost Accounting Division. There will also be discussions on the performance resulting from this endeavor.—Editor.]

Standardization of Locomotive Repair Parts*

Part 2

Manufacturing and Fitting Standard Knuckle, Crank and Crosshead Pins Requiring Frequent Renewal

By M. H. Williams

Knuckle pins and bushings are readily standardized similar to the smaller valve motion parts as previously explained. Therefore, when describing side rod parts there will from necessity be a certain amount of repetition of what has previously been stated.

Knuckle Pins

Fig. 11 illustrates a side rod knuckle pin of a design common to the majority of railroads. Step sizes are readily set for these pins, the magnitude of which is largely governed by the taper per foot of the two taper ends and the length of the body *A*. It is advisable as a general proposition to make the steps as great as these limiting conditions will admit. Assuming that the body *A* is 2 in. long, the steps for body diameter can be as follows:

Taper per foot	Steps
¾ in.	0.125 in.
1 in.	0.150 in.
1¼ in.	0.200 in.
1½ in.	0.250 in.

Step sizes for any length of body or taper are arrived at by dividing the taper per foot by 12 which gives the taper per inch and multiplying this product by the length of the body.

Having determined the diameters, the sizes for the taper ends *B* and *C* are readily calculated from the taper per inch *i.e.*, assuming that the body of the pin shown in Fig. 11 is 4 in. in diameter and 2 in. long and that each taper end is 1 in. long, the length from the right hand end of the body to the large end is therefore 3 in., which multipled by 0.083 in. (the taper per inch for 1 in. per foot taper) equals 0.249 or practically ¼ in., which is the amount the large end of pin should be blanked out greater in diameter than the body or, in this case, the large end will be 4¼ in. The larger end of the small taper *C* is preferably the same diameter as the body or, in this case, 4 in.

It is advisable to set the largest step size for any particular pin same as the maximum allowable reaming or forging sizes of the side rods. As an example: For rods where ⅜ in. enlargement of holes is permissible, the step sizes for nominal 4 in. diameter and 2 in. long body pins are shown in Table 3. Similar tables are readily made up for any diameter or length of pins.

Table 3

Step Sizes for Bodies or Bearing Surface of Side Rod Knuckle Pins with Bodies 2 in. Long

Taper per foot	Standard or First step size	Second step size	Third step size	Fourth step size
¾ in.	3.988 in.	4.113 in.	4.238 in.	4.363 in.
1 in.	3.988 in.	4.138 in.	4.288 in.	4.363 in
1¼ in.	3.988 in.	4.188 in.	4.363 in.	4.363 in.
1½ in.	3.988 in.	4.238 in.	4.363 in.	4.363 in.

Note—The sizes shown above are 0.012 in. smaller than the recommended bore of accompanying bushings.

In a shop where knuckle pins are kept in stock to step sizes as explained above, one of the sizes may be selected from stock and the taper ends ground to fit any size of taper hole in rods coming between the standard or new rod sizes and the maximum allowable.

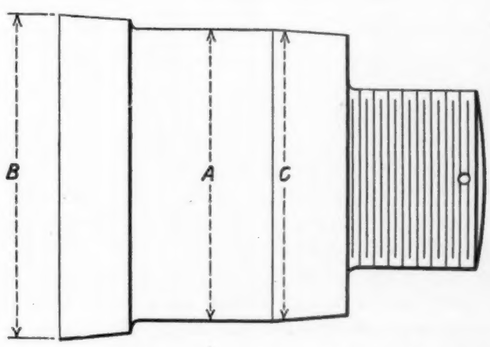


Fig. 11—Representative Side Rod Knuckle Pin

These pins, when made in the central production shop, should preferably be blanked out, holes for cotters or taper pins drilled, keyways milled, threaded, stamped showing catalog numbers, casehardened, body ground to size and placed in stock, following the same general plan as previously explained for valve motion pins.

*This is the second of a series of articles, the first of which appeared in the June issue of the *Railway Mechanical Engineer*, describing the methods that have successfully been adopted on one of the large railroad systems and which have expedited locomotive maintenance work and reduced the cost.

Knuckle Pin Bushings

Having determined the step sizes for side rod knuckle pins, setting the sizes for the accompanying bushings becomes a simple matter. The size of the bore can to good advantage be the nominal size, such as 4 in., 4¼ in., etc., with 0.012 in. larger than the pin body, the difference of 0.012 in. to allow for compression of the bushing when pressing into the rod and also for a running fit between the pin and the bushing.

The outside diameter of the first step size which is used with pins having standard bodies should as a general proposition, be about ¼ in. larger than the standard for new rods, the diameter of the remaining sizes increasing with the bore, *i.e.*, the walls all of the same thickness. Actual experience has shown this to be a happy medium for meeting conditions of repair work.

These bushings are readily made from forgings or seamless steel tubing on automatic chucking machines or turret lathes, it being the custom in the case of forgings, to bore and ream about 0.010 in. small, face ends and rough turn

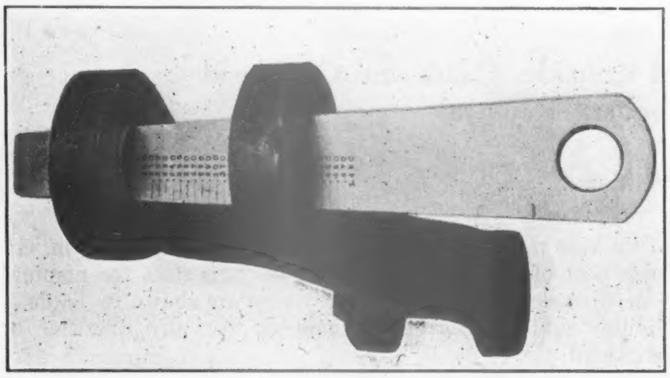


Fig. 8—Gage for Measuring Taper Holes and Checking Their Accuracy

the outside. When tubing is used the work is reduced to that of facing the ends and reaming.

After completion of the work on these machines, the oil holes are drilled, oil ways milled, stamped with catalog numbers, selective casehardened as explained later on, bore ground to sizes called for within a limit of plus or minus 0.001 in. and placed in stock.

Case Hardening, Selective

The requirements on a number of roads call for these bushings to be casehardened. In order to meet this condition and also admit of quick machining at the time of repairs, they are selective casehardened as follows. Five or six, or as many bushings as the casehardening boxes will accommodate are placed end to end forming a tube. They are held together during the casehardening operation by a central bolt and two end plates, the inside being filled with a casehardening compound while the vacant spaces in the box between the bushings is filled with burned foundry sand. As the gas from the casehardening compound comes only in contact with the bore of the bushings, this is the only surface hardened.

Grinding the Bore and Fitting to Rod

The bores of the bushings are ground on the same production internal grinding machines as the valve motion bushings, each piece being inspected with a plug limit gage. This method of internal grinding and inspecting insures a true cylindrical bore, which is desirable in order to form a satisfactory bearing on the knuckle pins.

In shops where side rod knuckle pin bushings are manufactured as explained, the work of fitting to the rods in repair shops is reduced to that of turning the outsides to the proper diameter and forcing into place. The usual practice is to measure the diameter of the rod bore with inside micrometers, place a bushing on arbor, turn or grind about 0.006 in. larger than the rod hole and force into place, the bushing being measured with outside micrometers. It is advisable to fit bushings to rods previous to fitting pins as explained in connection with fitting companion pins.

Fitting Knuckle Pins to Side Rods

The taper ends of side rod knuckle pins are preferably fitted to the side rods by grinding, similar to valve motion lever pins. One very good practice is as follows: The taper holes in the side rods are reamed sufficiently to remove all irregularities and true up, but without reference to sizes. When ready to fit the pin, the diameter of the taper holes in the rod is measured with a flat taper gage of the same general design as that shown in Fig. 8, made of suitable size and taper for rods of each particular class of locomotive. The size of the taper hole is read from the gage at the inside of the clevis as shown in Fig. 8. The pins are then ground following the same general practices as far as sizing and machine setting as described in connection with valve motion levers.

The pins are driven when grinding by a carrier pin projecting from the head stock face plate or by a treaded carrier similar to that shown in Fig. 9. The time taken when fitting taper ends of pins ranges from 6 to 10 min., largely governed by the time taken in going to and from the rods for the purpose of taking measurements.

Where the diameters of pin bodies are large, say 4 in. or greater or walls of bushings are comparatively thin, it at

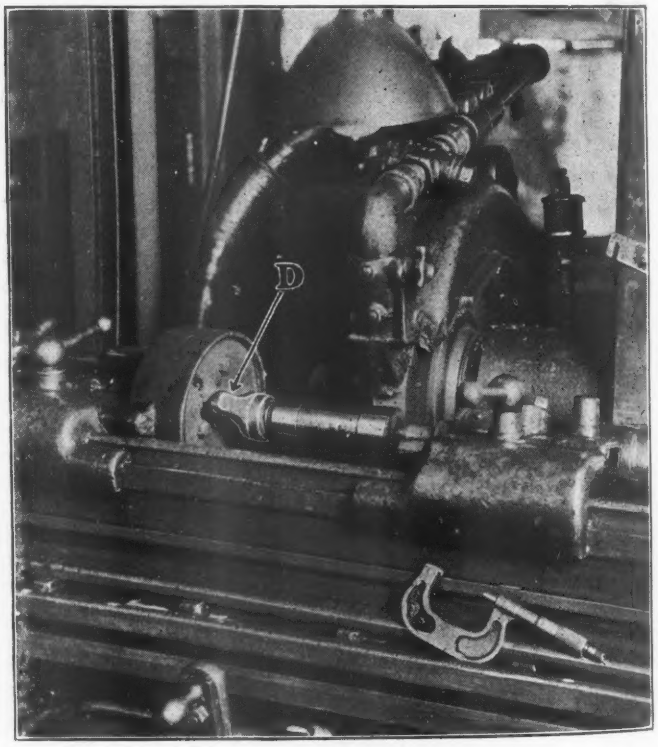


Fig. 9—Close-up View Showing How Taper End Bearings Are Ground

times happens that the compression of the bushing bore can not be controlled and as a result the bore of bushing which has been ground at the time of manufacturing to exact plug sizes will not be of a uniform diameter after forcing into the rod. In order to correct errors of this nature, the pins are tried in the bushing and if not of a proper fit the pin body is ground to the correct size.

When reaming taper holes in side rods, there is always the possibility of the top clevis springing owing to downward pressure applied when reaming, this being particularly noticeable with dull reamers. Errors in reaming are shown

up when the taper gage is tried in the holes, defective reaming being at once detected which has the effect of toning up the general grade of this work. Objections have been raised in certain shops to the frequent use in side rods of the conventional forms of cylindrical taper gages owing to the time required to thoroughly clean the hole, chalk mark gage, apply and examine the chalk marks in order to ascertain if holes were of the same taper as gage, a small amount of dirt or chips affecting the results. With the flat gage it is not necessary to clean the holes with great care, the usual practice being to rub the hole once around with waste, place gage in hole, give it about 1/8 turn which centers it. The gage is then tried for side shake at top and bottom. If there be an absence of shake at both ends, this is an indication that rod has been correctly reamed. Should the lower end admit of side shake, this indicates that lower member of clevis has been reamed too large in reference to the upper member.

Crosshead Pins

Crosshead pins are the same general design as side rod knuckle pins only differing in sizes, for which step sizes are readily set governing the body and taper ends.

In some shops, when making class repairs to the main rods, it is customary either to renew the front brasses or to close them by filling the abutting ends. In either event the brasses are, as a general proposition, bored to standard or drawing sizes. When this practice can be followed, the pin bodies are ground to standard sizes, likewise the brasses are bored to standard sizes. As a result the pins and brasses are interchangeable, each being a suitable size for a running fit with the other. This practice can be followed when new pins and brasses are used. However, conditions arise where the taper holes for pins in crossheads have been enlarged to a size where the smaller of the two taper holes is as large as the standard pin body. Where this condition is encountered it becomes necessary, in order not to scrap the crosshead, to make use of pins having bodies larger than standard, or resort to the questionable practice of bushing, or autogenous welding of the pin holes.

Another condition is met where crosshead pin bodies have been worn from service and they are trued up on the bearing surfaces and continued in use, the brasses being bored to a suitable diameter for a running fit on the pin. In some cases pins removed from crossheads are worn on the taper ends. These are laid aside and used in crossheads having smaller holes.

It would be difficult to lay down rules to govern crosshead pin sizes. As a general proposition, when manufacturing for repair work, it is advisable to make the body diameter to standard sizes, the smaller taper the same as the body diameter and the large taper a continuation of the taper per foot carried from the body size, similar to valve motion and knuckle pins as shown in Fig. 1. Step sizes from a shop standpoint may be about 1/4 in. larger and if permissible a larger step size, providing the design of the rod brass will admit of the necessary enlargement. These sizes must be determined for each design of crosshead.

The bodies should be ground to the diameters called for with a limit of 0.001 in. plus or minus, the taper ends rough turned, drilled, threaded, centered and key ways milled, in fact completed except machining the taper ends.

The taper holes for pins in crossheads, as a general proposition at times of repairing, are reamed in order to true them up and remove the effects of wear. The diameter of taper holes are readily measured with flat taper gages.

When turning or grinding taper ends, the same general plan of sizing can be followed as explained in connection with side rod knuckle pins.

Supplying repair shops with crosshead pins completed in all respects excepting the two taper ends reduces the time of applying to that of machining the taper surfaces, which is readily done on 12 in. by 36 in. plain cylindrical grinding machines.

Where the bodies are finished to close limits at the time of manufacture, the rod brasses are readily bored to plug gage sizes with the assurance that they will fit the pin. This insures satisfactory fitting, and in addition reduces the time required for boring the brasses.

Pins removed from crossheads which have worn or cut bodies are economically refinished on grinding machines used for taper ends, a good practice being to true the surfaces, measure with micrometers and make a memorandum of sizes. When boring brasses, the diameter is bored to micrometer sizes agreeing with the memorandum. The use of micrometers has the effect of improving the grade of fitting and the sizes shown on the memorandum become a record in event of mistakes.

Crank Pins

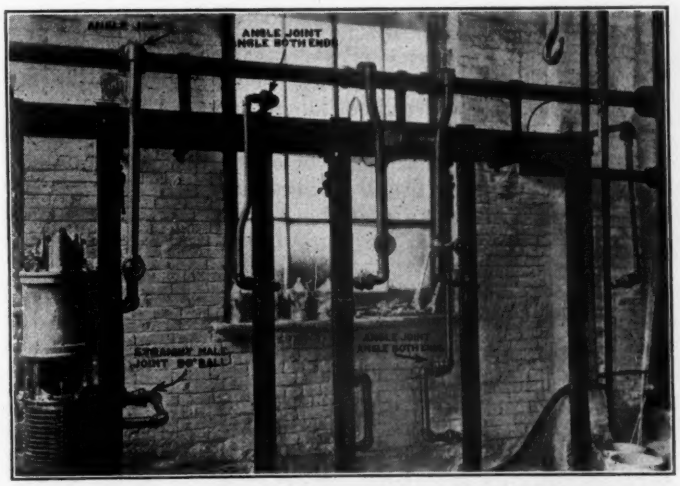
Crank pins are blanked out on center lathes or large turret lathes, a good practice being to rough machine the ends fitting the wheel center approximately 1/4 in. larger than standard, the part fitting rod brasses being turned about 0.020 in. large, collars faced, etc. The bearing surfaces are then ground to standard sizes to a limit of 0.002 in. plus or minus.

In the repair shop, it is only necessary to measure the diameter of the hole in the wheel center, which is preferably done with inside micrometers, and turn the pin about 0.010 in. larger and force into place. This reduces the repair shop work to a minimum.

(To be continued)

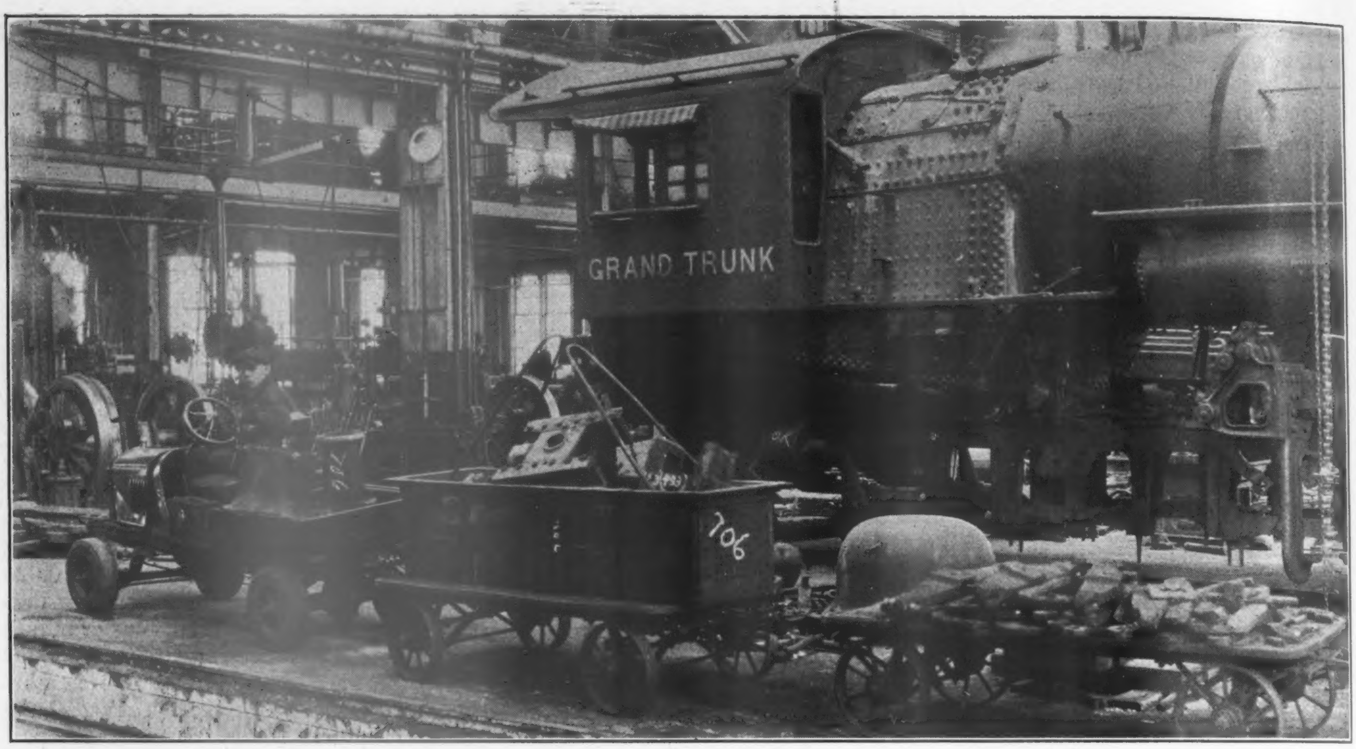
Convenient Air Pump Test Rack

To facilitate the connecting and disconnecting of the steam and air pipes when locomotive air compressors are set up for testing, the test rack shown in the illustration has been installed at the Jackson, Mich., shops of the Michigan Central. All pipes leading from the mains to the pump are fitted with Barco joints so that they possess complete flexibility. In setting up a pump for testing, no changes or adjustments in the piping are necessary other than attaching the nipples to the pump and connecting the unions on the ends of the flexible leads.



Air Pump Test Rack With Flexible Pipe Connections

The construction of the rack is clearly shown in the illustration. The vertical members are spaced to fit the various sizes of pumps coming into the shops for repairs. Stirrups are bolted to the uprights, and in these the pump lugs are supported. Bolts are inserted through the top lugs to prevent movement of the pump while under test. An air hoist is provided for handling the pumps on the repair bench and to and from the test rack.



This 1-Ton Ford Truck Cut Down Proves a Flexible Power Unit for Hauling Loaded Trailers

Erecting Shop Practice at Battle Creek*

Many Efficient Devices and Methods Facilitate Erecting Work at Grand Trunk Locomotive Shops

By M. H. Westbrook
Shop Superintendent, Grand Trunk, Battle Creek, Mich.

THE suggestion that erecting shop foremen "wake up" and tell each other about labor-saving methods is rather timely for, as a class, these men say little for publication. This may be on account of excessive modesty or possibly because they are usually a very busy class of men. The following is a description of the manner in which erecting shop work is handled at the Battle Creek shops of the Grand Trunk.

For the purpose of making comparisons month by month with the corresponding periods of the previous year, there has been worked out a system whereby each week's output can accurately be gaged and indicated on what is known as the output meter, as shown in Fig. 1. The relative value of a Class 6, 5, 4, 3, 2, or 1 repair, using the U.S.R.A. system of classification, is designated by points. Thus for a Class 6 repair, one point is allowed; a Class 5, twelve points; Class 4, eighteen points; Class 3, thirty points; Class 2, forty points, and Class 1, fifty-two points. These relative values were carefully worked out by calculation of the output of two years and take into consideration labor costs only. Thus it has been found that the average labor costs of a Class 3 repair is thirty times that of an average number of Class 6 repairs. This, of course, would vary with local conditions should any other railroad shop organization wish to introduce this method.

The calculations, which are the actual figures used for the months of January, 1921 and 1922, in computing the units of effort for the two periods mentioned, were made as follows:

RESULTS FOR THE MONTH OF JANUARY

	1921	1922
Engines out	20	9
Points made	381	206
Number of men	513	543
Shop-hours	164	72
Man-hours	84,132	39,186
Man-hours per point	221	190
Monthly percentage:		
Gain	...	14 per cent
Loss	...	...
Yearly percentage	...	...

ENGINES TURNED OUT BY CLASSES

Class	1921	1922
1	...	...
2	...	1
3	10	5
4	5	1
5	2	...
6	3	2
Total	20	9

From the table it will be seen that although twenty engines were turned out in January, 1921, and but nine in the same month of 1922, still the man-hours to produce a point were 190 compared with 221 for the corresponding period, or a gain of 14 per cent. The columns to the right of the meter are used to total the gains or losses, month by month, until the end of the year. All figures for the corresponding periods are on red cards while those for the current period are on white ones, which are slipped into the frames after being stamped as shown on the drawing.

This method keeps all foremen and men thoroughly con-

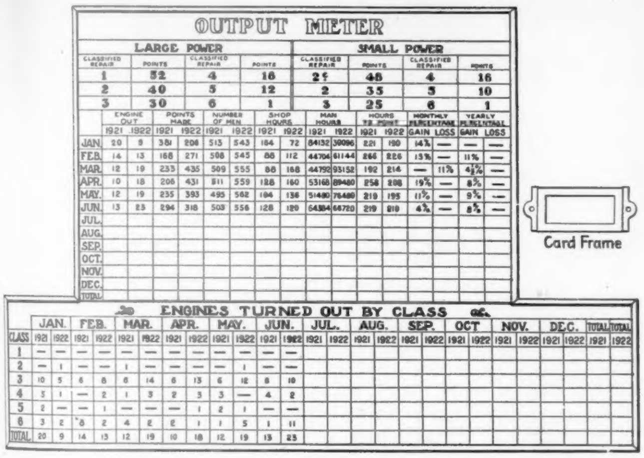
*Awarded the first prize in the Erecting Shop competition.

versant with any fluctuations in the amount of work performed, making it a simple matter to locate causes of fluctuations. This system is a much more accurate measure of what is actually being accomplished in the erecting shop than the old-time method of comparison of total engines turned out, with its attendant grounds for arguments and excuses.

The shop referred to has 22 pits served by one incoming and one outgoing track. Engines are all inspected and stripped on the pit at the end of incoming track. The boiler, erecting and machine foremen are present at the inspection, each one having a copy of the report previously sent in by the road master mechanic, for the purpose of insuring that the necessary castings, etc., are on hand in due time.

Trailer System for Handling Material

All parts removed are marked—the smaller pieces being placed in heavy wire baskets—loaded on trailer trucks and sent to a cleaning vat just outside the shop where they are handled by a crane and pneumatic hoist. Driving wheels are put in a cleaning vat located in the wheel department by a 10-ton traveling crane. From the vats mentioned, material is distributed to the various departments, such as mo-



OUTPUT METER

LARGE POWER				SMALL POWER			
Classified Repair	Points	Classified Repair	Points	Classified Repair	Points	Classified Repair	Points
1	52	4	16	1	48	4	16
2	40	5	12	2	35	5	10
3	30	6	1	3	25	6	1

	Engine Out		Points Made		Number of Men		Shop Hours		Man Hours		Hours Per Point		Monthly Percentage		Yearly Percentage	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	Gain	Loss	Gain	Loss
JAN.	20	9	381	206	513	543	184	72	84132	39096	221	190	14%	—	—	—
FEB.	14	13	168	271	508	545	88	112	44704	61144	266	226	13%	—	11%	—
MAR.	12	19	233	435	509	555	88	168	44792	93152	192	214	—	11%	4½%	—
APR.	10	18	206	431	511	559	128	160	53168	89480	258	208	19%	—	8%	—
MAY.	12	19	235	393	495	562	104	136	51480	76480	219	195	11%	—	9%	—
JUN.	13	23	294	318	503	556	128	120	64384	66720	219	210	4%	—	8%	—
JUL.																
AUG.																
SEP.																
OCT.																
NOV.																
DEC.																
TOTAL																

ENGINES TURNED OUT BY CLASS

	JAN.		FEB.		MAR.		APR.		MAY.		JUN.		JUL.		AUG.		SEP.		OCT		NOV.		DEC.		TOTAL	TOTAL
CLASS	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
1	—	—	—	—	—	—	—	—	—	—	—	—														
2	—	1	—	—	1	—	—	—	—	1	—	—														
3	10	5	6	8	6	14	6	13	6	12	8	10														
4	5	1	—	2	1	3	2	3	3	—	4	2														
5	2	—	—	1	—	—	—	1	2	1	—	—														
6	3	2	8	2	4	2	2	1	1	5	1	11														
TOTAL	20	9	14	13	12	19	10	18	12	19	13	23														

Card Frame

Fig. 1—Output Meter Which Visualizes the Comparative Monthly Shop Productions

tion, rod, wheel, air brake, etc., which are in charge of foremen responsible for the work. A 1-ton Ford truck which has been cut down and shortened so that it can be run freely to any part of the shop is used for such distribution. Two floor lines are marked throughout the whole shop, no material of any kind being permitted to be placed between them, thus insuring a clear right of way to any shop or department. The introduction of this truck, which is shown in the leading illustration, does away with several laborers and provides prompt service.

Small boxes are hung at convenient locations as a receptacle for trucking orders. The driver picks these orders up at regular intervals on making his rounds.

Boiler Work Limits Shop Schedule

After the internal inspection is completed, the engines are then listed for completion at a given date, usually governed by a boiler foreman's report. A schedule routing board (Fig. 2) adapted to suit local conditions but similar to those in general use, shows in white chalk figures the dates every essential part is to be completed and delivered to the pit to which the engine has been assigned. A blue chalk figure indicates the date completed, if on or before date requested. If late, red chalk is used. In addition to the complete master

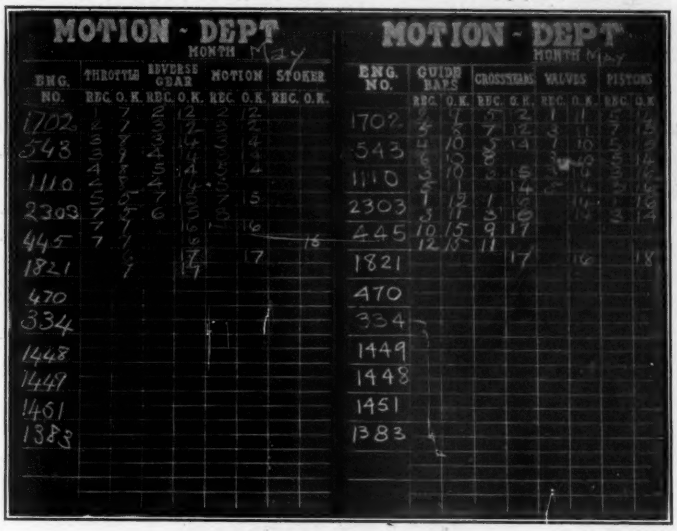


Fig. 3—Example of Typical Department Schedule Board

board kept in the erecting shop foreman's office, each department also has a board similar to the one shown in Fig. 3, showing the dates material must be delivered.

Foremen's Meetings a Consultation of Experts

Foremen's meetings are held three times a week, immediately after work ceases, and each delay is thoroughly discussed. Under the heading, "My Principal Trouble," each has an opportunity to explain delays in his department. These meetings are in no way, as is too often the case in some shops, arenas where hard feeling, enmity and discord are engendered between foremen or heads of departments, but the idea is successfully conveyed that each meeting is a consultation of experts called in to analyze a condition and offer suggestions for improving it, just as a body of medical men would be expected to discuss a difficult case when called upon.

This has resulted in developing an organization, any member of which in an emergency such as the enforced absence

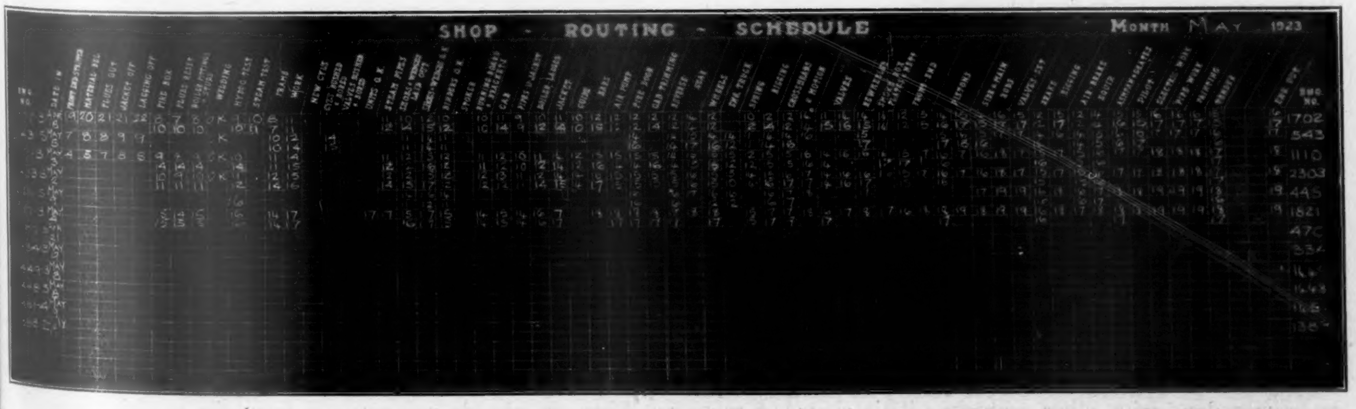


Fig. 2—Master Schedule Board—Dates Due Are Shown in White Chalk; Dates Completed in Blue Chalk, or Red If Late

of a department head, could take hold and temporarily, at least, carry that department along successfully. Thus the forge shop foreman becomes thoroughly familiar with all the troubles or joys of the boiler shop foreman. The boiler shop foreman appreciates that he is not the only one who has troubles, but is thoroughly familiar with, and can clearly see the erecting shop foreman's difficulties. The sheet metal foreman understands the paint shop foreman's troubles and thereby can and does aid in preventing them. All other foremen also are placed in a similar situation and willingly co-operate to prevent delays because each has heard the other's difficulties, handicaps, or successes thoroughly discussed at these meetings which are kept by the chairman from dragging out by limiting each speaker to three minutes in which to present his case and allowing no meeting to last over 45 minutes.

Labor-Saving Devices and Methods Used

In describing labor-saving devices and methods used to facilitate the work of the erecting shop, it is almost impossible to state these in any regular sequence or order; therefore, they will be presented just as they occur to the writer.

Taper Bolt System.—Taper bolts with a taper of 1/16 in. per ft. are used wherever possible, all being turned to fit holes made in standard master gage blocks (Fig. 4) and kept in the bolt department. The erecting shop is provided with several sets of complete taper gage plugs following each other in sizes from one to 48, Fig. 5 showing a set of plugs and the stand for holding them.

No more material is reamed than necessary to make a good

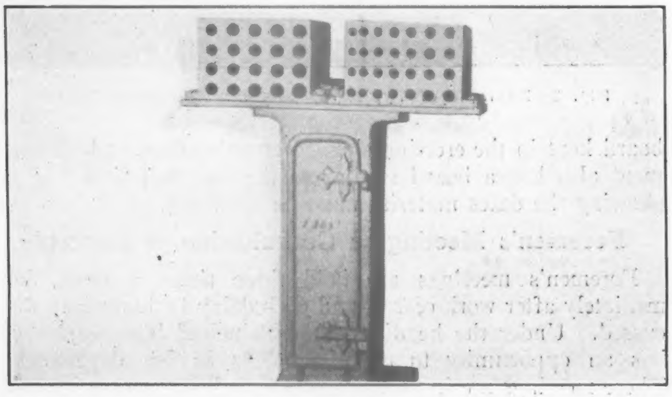


Fig. 4—Master Gage Blocks for Taper Bolts Kept in the Bolt Department

hole. A taper plug is then put in and the distance it measures from one of several numbered grooves, struck around each plug about 3 in. apart, is noted and an order given for the required number of bolts. Thus an order on the machine shop might read as follows:

Supply: Six 8-in. bolts, No. 36, 3/4 in. out
Four 8-in. bolts, No. 32, 1 in. out
Ten 9-in. bolts, No. 20

Bolts are then turned to fit the gage blocks at the lathe (the amount allowed for drive has been included in the order) in accordance with instructions. The No. 20 bolts go in to the head because the plug went to No. 20 line within driving distance.

By this method it is not necessary to have lathe hands go near the erecting shop to fit bolts. On new work, such as cylinder saddles, etc., all are reamed out to one size.

Reamers for Taper Bolts.—The best reamers found for this work have a left-hand spiral with but four flutes and are made from high-speed steel with flutes rolled, not milled, and twisted while hot. This makes a very free cutting, tough reamer having so much chip room that it never is necessary to remove one from the hole to clean out the chips which is sometimes done with other reamers. This shape of reamer alone is a great time-saver over any other style. The following is a report of some actual tests made, using an air motor to drive the reamers:

	Four-flute Spiral Reamer	Nine-flute Straight Reamer
	Not removed from hole until finished	Reamer removed frequently to remove chips
Number of holes	12	12
Diameter of holes	1¼ in.	1¼ in.
Length of holes	8 in.	8 in.
Time required for reaming	24 min.	54 min.

The cuttings from these reamers frequently curl up several inches, giving the appearance of having been made in a lathe which is an indication of the free-cutting quality of the tool.

The bolts are turned to the correct taper on specially de-

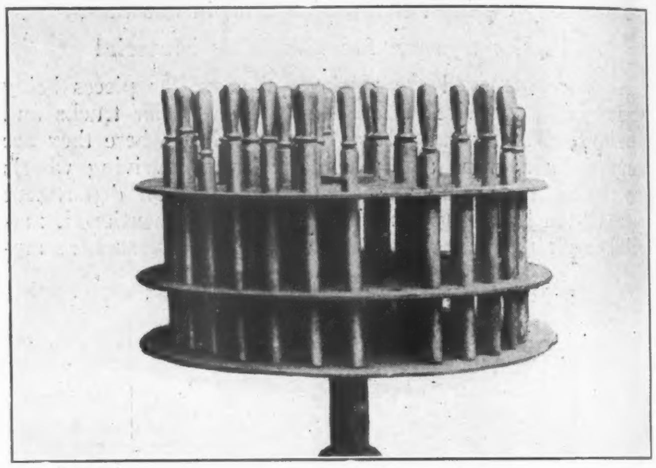


Fig. 5—One of Several Sets of Taper Gage Plugs Used in the Erecting Shop

signed lathes made in the shop, having the ways planed off the center line 1/32 in. per ft., which makes it a very positive and simple matter to turn them to the desired taper with no adjustment of taper attachments or setting over the tailstocks when bolts of varying lengths are to be turned.

Removal of Bolts.—Bolts are removed by driving a long tapered split steel wedge under the heads. A careful acetylene torch operator can, when necessary, burn a slight groove under the heads to allow the wedge points to enter.

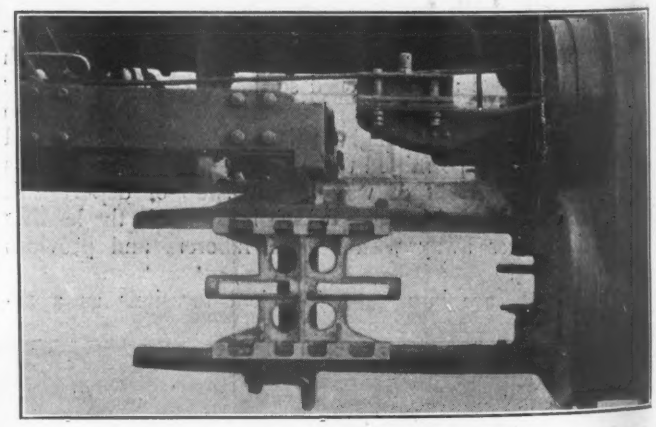


Fig. 6—Aluminum Dummy Crosshead for Lining Guide Bars

Broken bolts have to be removed by drilling when other methods fail.

Lining Guide Bars.—Guide bars are lined in the usual manner by passing a line through the cylinder. After lining the bottom bar, a skeleton made of aluminum (Fig. 6), an exact counterpart of the regular crosshead, is used. This is placed on the bottom bar and, being very light, is easily handled. The top bar is then set upon this dummy and the lining up completed quickly and in a most accurate manner. When crossheads are received from the machine shop, it is absolutely certain they will, if properly planed, go into place

The use of the aluminum dummy makes it extremely simple to set the bars to correct alinement.

Truck for Applying Crossheads.—The special elevating truck (Fig. 7) is used to place the crosshead in position. To do this with a crane requires considerable effort since the lifting cables must be pushed out of line under the obstructing parts above. With the truck a crosshead can be backed up to the guide bars, elevated by the screw to the correct height and slid into place by one man. The two end upright members shown are pipe guides for the purpose of keeping the lifting piece square with the guide bars.

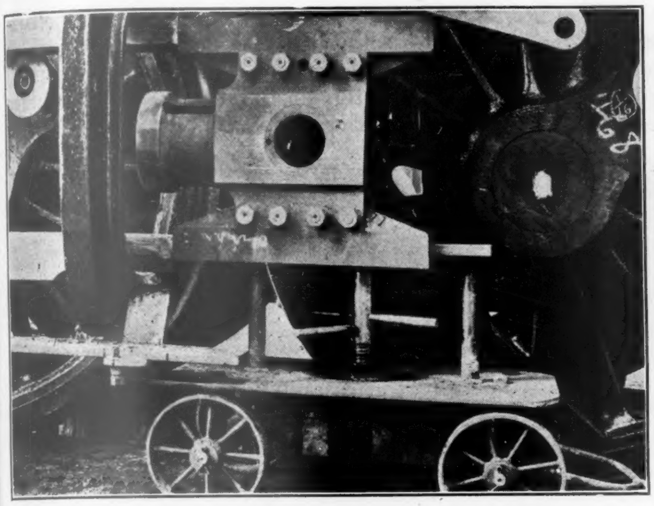


Fig. 7—Elevating Truck Assists in Applying Crosshead

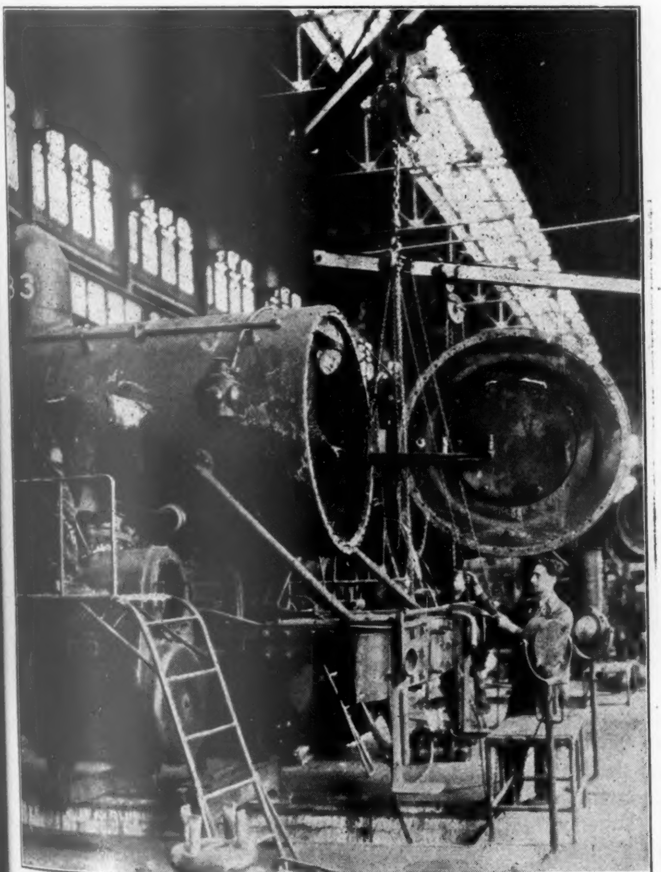


Fig. 8—Jib Crane with Double Hoist Being Used to Install Superheater Units

All guide bars are kept to a standard width by applying strips of cold rolled steel, 2¼ in. by ¼ in., to the sides, held in place by ⅜-in. copper plugs 1⅜ in. long and spaced 5 in. apart. A 5/16 in. steel ball is first dropped in each rivet hole, spreading the bottom of the plugs when the latter are driven in to fill the countersunk holes in the liners. This is cheaper than welding on liners and in several years none applied by this method have been known to loosen or give trouble.

Superheater Units.—Superheater units are removed and, unless broken, are repaired alongside the engine, our experience being that if they are not leaking when removed, the least work done upon them the better. They are cleaned with an air motor, using slotted disks of emery cloth, the slots preventing them from crumpling up when in use. They are used merely to clean up the joints both on the header and the unit, after which the units are tested by a small hydraulic pump and reapplied. Fig. 8 shows the method of lifting the units when replacing them.

Between every other pit is a jib crane equipped with a 2-ton chain hoist to relieve the overhead traveling cranes of much light lifting. When lifting light loads, the small ½-ton or ¼-ton high-speed chain hoists are hooked upon the larger ones. This appears to be a small item but it certainly counts up during the year when thousands of light lifts are made. The lifting tongs shown are also of interest.

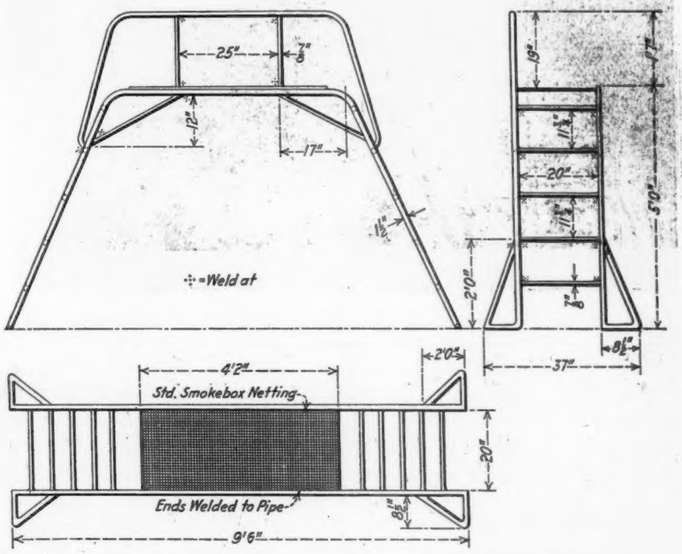


Fig. 9—Details of Convenient Platform Illustrated in Fig. 8

Platforms.—To avoid working on ladders or poorly-made platforms around the engines undergoing repairs, special platforms that can be easily handled by two men are made in the welding department from scrap pipe and old netting. These platforms are handy in many respects, especially for straddling the pits while working in cabs. The use of one of these platforms to facilitate working around a steam pipe joint on top of a cylinder is also illustrated in Fig. 8, details of the platform being shown in Fig. 9.

Portable Lighting Stands.—Portable electric light stands always are available and during dark days can be instantly lighted, it being impossible for men to work efficiently unless there is adequate lighting facilities around the pits. Two of these stands are shown in the foreground at the right of the pit in Fig. 8. Pits are also whitewashed every two weeks with a machine to improve the lighting, the whitewashing being made from used acetylene carbide.

Smokebox Doors.—Front end doors are equipped with patent hinges, as shown in Fig. 8, and the labor of removing the door and frame at each shopping is thereby saved. This is a great convenience as the disposition of these doors when removed is somewhat of a problem in an already crowded shop, to which any erecting shop foreman will agree.

Wheeling.—When valves are not to be set by the use of rollers, or when engines are equipped with Young valve gear, they are wheeled by the method shown in Fig. 10. Rods are placed on the wheels and binders are arranged in the position shown upon suitable jacks. The construction of the cross plates and screw jacks is clearly shown in the illustration. Turning the sleeves by means of a small bar raises the binders into place under the frame pedestals. A heavy

Fig. 10—Ready for Wheeling—Binders on Jacks and Rods on Wheels

engine can thus be wheeled completely with the least amount of laborious hand lifting in a very short time. Portable pneumatic hoists of the type illustrated in Fig. 11 are also used sometimes for applying binders. The cylinder in this case is made of brass and the jack can easily be handled by one man. All binders on an eight-wheel coupled engine can be tightened in place in less than one hour.

When valves are set by the use of rollers, the main rods are always first applied and readings taken in every position.

Fig. 12 shows a special truck used when wheeling, it having two receptacles, the larger one containing sufficient 1½-

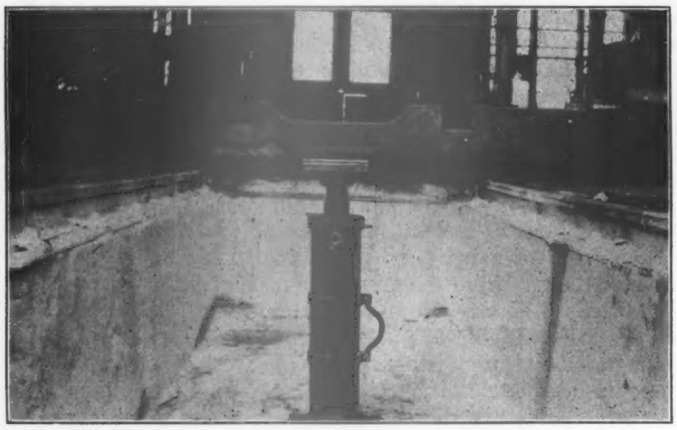


Fig. 11—Light Air Hoist for Lifting Binders

in. nuts required for the engine being wheeled; the smaller one, holding the cotter keys to be used for the same purpose. This truck always remains in an upright position by gravity. Nuts and cotter keys are taken direct from the petty store by this truck to the wheeling pit as required.

Removing Piston Valves.—Some piston valves prove difficult to remove, the device shown in Fig. 13 then being used. A Westinghouse 12-in. air brake cylinder has replaced the one shown, which was not large enough. A chain is passed around the arms of the spider, each end of which is caught on a special grab attached to the end of the piston rod, and as the valve moves outward, the chain is shortened to suit. The device is swung at its center of gravity from a jib crane and operated by air.

Spring Rigging Standardized.—All spring gear is standardized and jig-drilled and bushed. This was not done on some of the engines when built, the equalizers having to be plugged and redrilled at the first shopping. All bushings are made on a forging machine to the correct size inside.

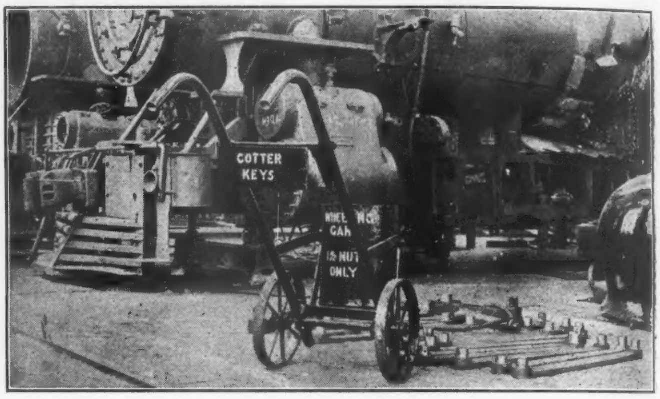


Fig. 12—Truck Containing Nuts and Cotter for the Wheeling Gang

Machining the internal diameters is therefore eliminated. Bushings are then turned on a special eccentric arbor designed to turn them 1/16 in. thicker on the side that takes the weight. With the hard surface left by the plunger, this adds materially to the life of the bushing. After being turned, the bushings are case-hardened and stocked in large quantities. It is a question if this case-hardening is necessary.

Bushings over 3 in. in length are applied in two pieces, being more easily forged when short. An opening is left between them of 3/16 in. which does away with the necessity of drilling oil holes. The opening also acts as an oil cellar, insuring proper lubrication.

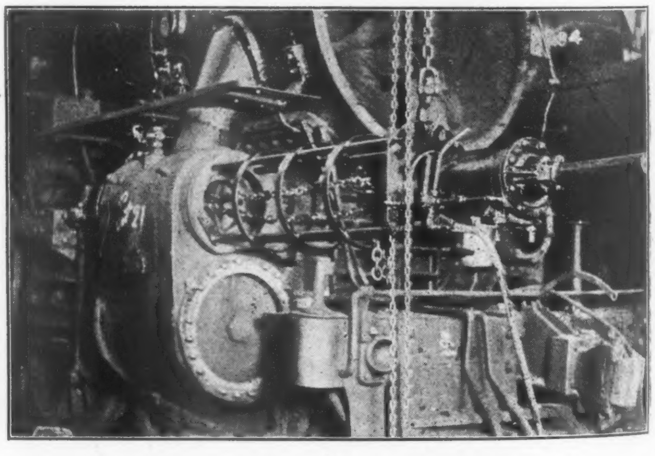


Fig. 13—Pneumatic Device for Pulling Piston Valves

When renewing spring rigging bushings it has been found that instead of transporting the equalizers to a press, a long-stroke air hammer fitted with special knockouts can quickly remove the old bushings. The new ones can then be applied immediately from stock. Frequently this work is carted a considerable distance to a machine shop where a regular press is used, but this use of an air hammer saves considerable time and labor by doing the work adjacent to where the parts are used. A set of spring hangers with bushings ready to apply and the long-stroke air hammer used for this pur-

pose are shown on the floor at the right of the truck in Fig. 12.

Applying locomotive springs is usually an awkward operation without some such device as that shown in Fig. 14. This illustration shows plainly the use of the lifting rod in placing the spring in position, Fig. 15 giving details of construction.

Applying Cylinder Bushings.—All cylinder bushings also are applied in two lengths, being bored, turned and cut off at one setting on a vertical boring mill. Bushings can be completed in this manner in much less time than by the

Fig. 14—Driving Springs Are Readily Placed in Position by This Method

usual practice which is to bore them on a horizontal mill, then transferring them to a lathe, applying centers and finishing the outside diameter. This method usually distorts the inside bore through taking the rough scale from the outside after the bore is completed. Cylinder bushings are also much more difficult to apply when in one piece.

In Grand Trunk practice the two short cylinder sections are left 1/8 in. below size in inside diameter and if no distortion takes place in applying, which is frequently the case,

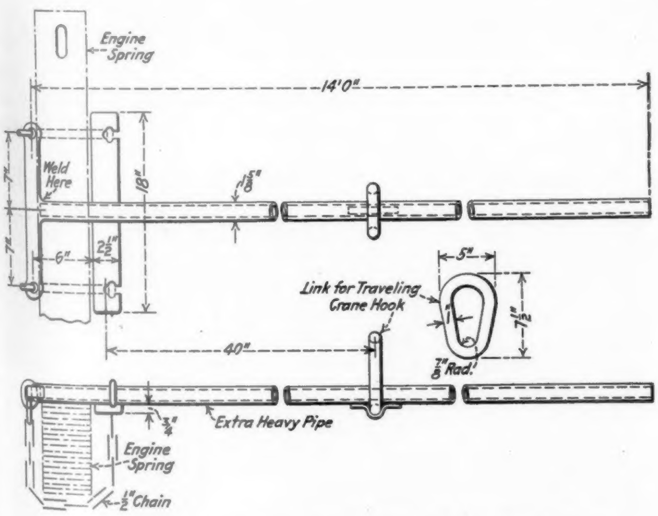


Fig. 15—Details of Device for Applying Driving Springs

they are not rebored, the amount they have been left small adding to the life of the bushings and not materially affecting the capacity of the locomotive. Of course, great care must be exercised in seeing that both sections are bored exactly the same diameter.

In applying the bushings, the cylinder is first slightly heated by the burner made from a length of 3/4-in. pipe plugged at one end, having 1/16-in. holes drilled alternately along opposite sides and placed on the bottom of the cylinder. The open end is piped to a regular portable oil heater. The gases generated in the pipe, when lighted, envelope the walls of the cylinder, meeting at the top and quickly heating it sufficiently to permit the bushings to be slipped into place. They are held close together at the joint by a heavy clamp at each end with a 1½-in. bolt tightening them and left until cool, the nut occasionally being tightened to take up the contraction.

Removing Cylinder Bushings.—The removal of worn bushings is quickly accomplished by a skillful use of the carbon electrode. They can be cut in 12 minutes without damaging the cylinder wall in the least. This operation is performed in some shops with air hammers and chisels, taking several hours to remove a bushing. All valve chamber bushings are rebored to standard diameters, increasing by 1/8 in. over the last boring.

Washout Plugs.—All washout plugs, which have good square ends on removal, are sent to the machine shop and recut to the next lower size, all sizes being represented by a number and no intermediate sizes are allowed to be used.

Crank Pins Maintained True.—All worn crank pins having threaded ends are trued with a special portable pin-turning machine which is attached to the threaded portion of the pins and makes an accurate and quick job of restoring these to their original form and in accurate quarter. A pair of main pins can be re-turned in less than three hours. Pins of

Fig. 16—An Efficient Device for Drilling Retaining Ring Rivet Holes in Wheel Centers

the Walschaert gear type are turned by an attachment in the quartering machine.

Drilling for Retaining Ring Rivets.—A pneumatic feed for the motor while drilling retaining ring rivet holes in driving wheels, or work of a similar nature as shown in Fig. 16, is quite effective. One valve acts to permit admission of air to operate the motor; the other admits sufficient air to support the motor in position and automatically feeds the drill into the work as fast as the operator wishes or the drill will permit.

Auxiliary Pits.—An auxiliary pit, 6 ft. long by 3 ft. wide by 3 ft. deep, on each side of a regular pit is a great convenience in preparing broken cylinders by patching or welding. One of the erecting pits in a shop so arranged will be found well worth while. The one shown in Fig. 17 is cemented and, when not in use, covered by a neat-fitting plate with ring for removal when necessary.

Pit Jacks.—All locomotives are placed upon pit jacks similar to the one shown in Fig. 18. These pit jacks are designed for maximum strength in proportion to weight and are safe and relatively easy to move about. They take far less room than the ordinary clumsy 12-in. or 14-in. timbers.

Lifting Air Reservoirs.—The device applied to the portable crane as shown in Fig. 19 is exceedingly handy for lifting or lowering air reservoirs. Considerable difficulty is met with when applying reservoirs with the overhead crane on

account of being obliged to force the lifting cables out of line in order to get the reservoir under the running boards. With this device reservoirs are readily rolled onto the arms and lifted from the floor into position beneath the running board by two men. The arm is easily and quickly removed when the crane is to be used for other purposes, it merely being necessary to remove the pivot pin.

Referring to Fig. 19, the construction of the device will be evident. The elevating arm is made of two pieces of 5/8-in. by 2½-in. stock, shaped at one end in a segment of a circle to fit the reservoir and separated by spacing rods. The arm is pivoted on a pin bolted through the framework of the crane which has been re-inforced at this point by two 5-in. by 5-in. plates welded to the frame. In operation, the radial elevating arm swings to the floor to receive the air reservoir which is rolled onto the arm. Application of the crane hook to the cross brace on the elevating arm and operation of the crane will then elevate the reservoir quickly and easily into place.

Welding.—The fullest advantage is taken of autogenous welding, both electric and acetylene processes being used. A large amount of welding is done with a portable, one-man,

Fig. 17—Small Auxiliary Pit Proves Convenient in Welding Broken Cylinder

semi-automatic welding machine, using the electrode from a reel containing 100 lb. of wire. An operator can work at least 15 per cent faster with this than with the ordinary type of machine, the metal deposited being automatically fed, his only concern being to watch his arc. No delays occur changing the short electrodes in general use and no short ends are wasted. An actual test under normal conditions showed a gain of 17 per cent in favor of the semi-automatic method of welding, especially on a big job.

Wrenches.—All wrenches, spanners, etc., are kept in special iron cupboards, one for each four pits. The special multiple cast-steel wrench shown at the left in Fig. 20, is found useful and can be used on ¾-in., 7/8-in., 1-in. and 1⅛-in. hexagon nuts. A hole is tapped for a piece of 1-in. pipe used as a handle.

The high-speed wrench is also interesting and useful in removing and applying nuts on such parts as cylinder heads and places where a number have to be applied. After entering a nut on a stud, the wrench is applied and the wheel spun around at a high rate of speed, the hand grip not revolving with the wheel. The momentum carries the nut along until it is in a position to be finally tightened in the usual manner. Different size sockets can easily be applied to the revolving spindle. This will be found a time-saving device. It is illustrated at the right in Fig. 20 and shown in detail in Fig. 21.

Broken Asbestos Lagging.—This is removed to a shredding machine in a special building outside and ground into material which is then used for making a plaster for lagging.

Accident Prevention

No foreman can expect to obtain the best results with employees losing time through accidents from whatever cause.

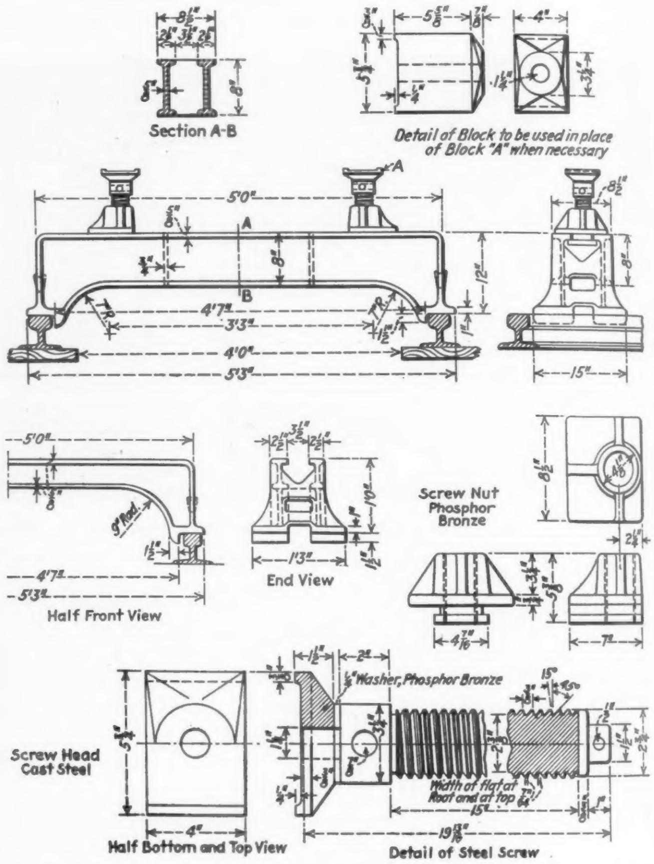


Fig. 18—Assembly and Details of a Convenient and Rugged Erecting Pit Jack

He has just so many men on his roll and to keep as many as possible of this number continuously at work should be one of his principal concerns.

A committee on safe practices meets once a month to discuss these. Should a man become injured, as soon thereafter as consistent, he is asked to what he attributed the

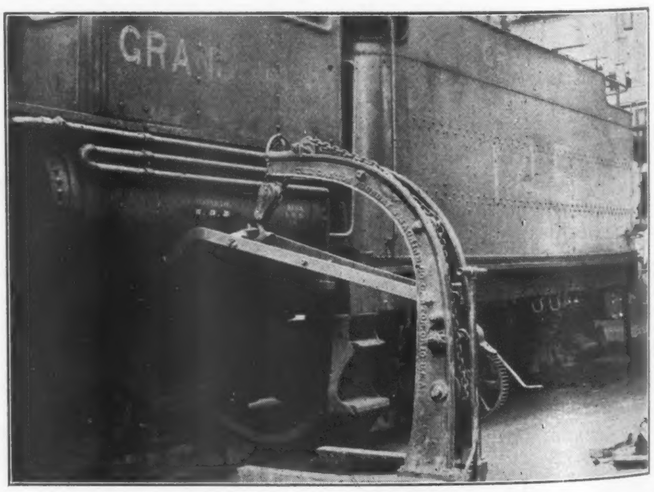


Fig. 19—Portable Crane with Attachment for Applying Air Reservoirs

accident and what he would suggest should have been done to have prevented it. A recording meter is set up in the shop, as shown in Fig. 22, and changed each month. After each accident, a sliding shutter is pulled down to equal the number of points that particular department is penalized. Each department is penalized an amount proportionate to the num-

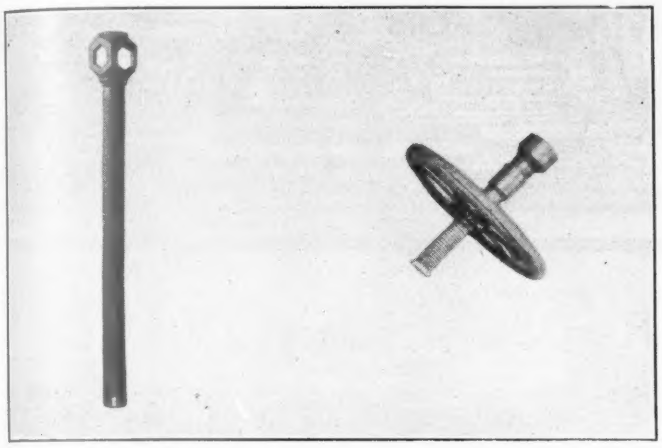


Fig. 20—Compact Multiple Wrench Design—High-Speed Socket Wrench

ber of men in same, each starting off the month with a credit of 1,000 points. At the end of the month, a summary is made out and recorded at the bottom as shown. Thus for January, the machine shop ended with 987 points; the erecting shop with 981, while the carpenter shop had 1,000 which indicates no accidents occurred in that department. In addition to this, the total number of man-hours lost due to casualties is posted each month. It has been found this meter has created an amount of inter-department rivalry to see which can get through each month with the least amount of time lost due to accidents. Fig. 22 shows shutters purposely pulled down for the purpose of illustration.

It seems that, as Americans, we are possessed with a certain amount of sporting instinct and anything which savors of a contest, is entered into quite readily. Thus the acci-

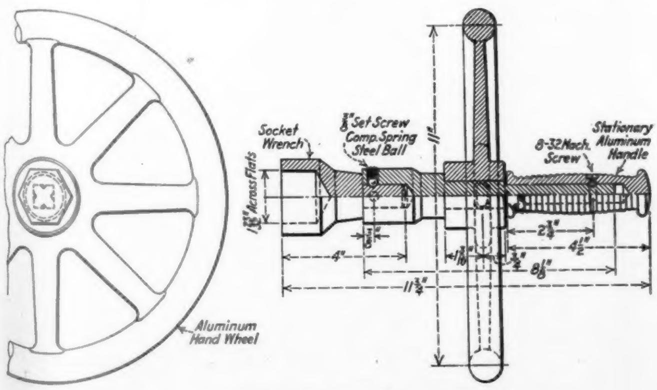


Fig. 21—Details of High-Speed Socket Wrench

dent meter board is watched, especially at the close of the month, by men in all departments in a manner similar to the way a baseball score board is looked upon, and we feel that the results obtained are very satisfactory and well worth the trouble of keeping it up. The various colored glass strips, representing the different departments, give it a most attractive and interesting appearance. The sliding shutter has a graduation upon it showing when pulled down, say 5 points, the figure 1, which indicates that one accident has happened, and so on until it reaches the bottom, which position, I am pleased to state, none has ever yet reached. Anyone passing it can see instantly just how many accidents have occurred during the current month to date and also in what department they took place.

While flower gardens may appear out of place in a description of erecting shop practices, we do not believe that a nice green spot with plenty of flowers for men to sit in during noon hours in the least detracts from their usefulness or interest in their work. Fig. 23 gives a faint idea of the charm and restfulness suggested in the lawn and flower beds kept up by the employee members of the shop horticultural society which has been in continuous existence since 1904. The garden is situated just outside the entrance to the erecting shop

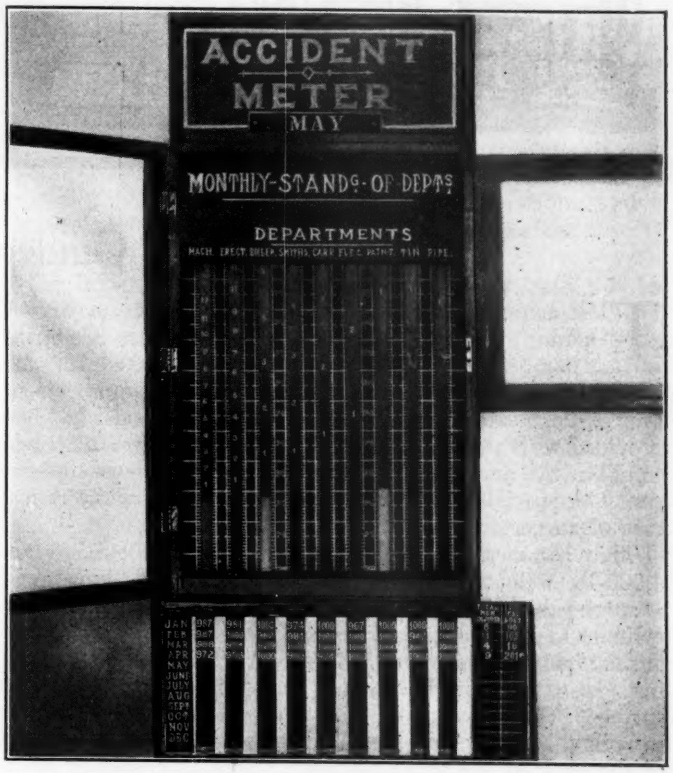


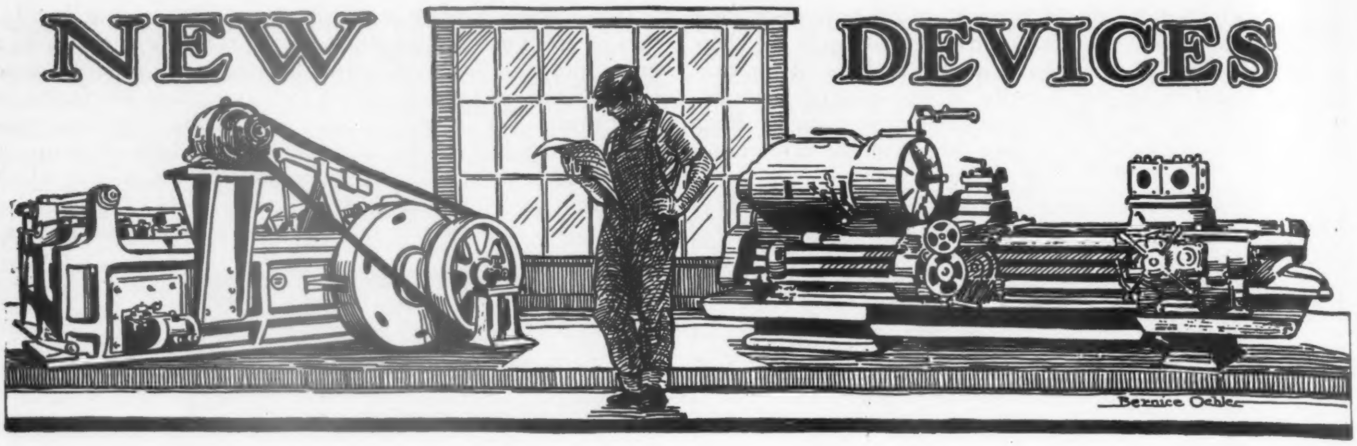
Fig. 22—Great Interest Is Evinced in the Accident Meter Which Compares the Records of the Various Departments

and is not considered one of the least of our united efforts toward the greatest efficiency.

It must not be understood that every device or method mentioned is original with this shop, or never before described. Some have been adapted from the *Railway Mechanical*

Fig. 23—Lawn and Flower Garden Maintained by the Shop Forces

Engineer, others through exchange of ideas. Many have been suggested by various foremen and workmen. We also have in our erecting shop one man whose sole duty is to see that each device, tool, etc., is kept in an efficient and safe condition and to develop ideas or suggestions that may be presented for discussion at the foremen's meetings and relate particularly to erecting shop practices.



Single Frame Guided Ram Steam Hammer

THE latest model 3,300-lb. single frame steam hammer made by the Chambersburg Engineering Company, Chambersburg, Pa., is particularly adapted for railroad blacksmith shop work and has several improvements over earlier models. The cylinder of the new model has been provided with a self-draining feature which prevents cylinder troubles by draining all water that accumulates between runs. A special safety valve arrangement lowers the ram in case of an accident to the valve gear.

This hammer, which is built in sizes 3,300, 3,500 and 4,000-lb. weight, is of the guided ram type, designed with a special high frame. Great care is given in casting the cylinder to secure a clean, sound casting. The neck is bronze bushed for the piston rod fit and is provided with a packing gland made in halves for easy removal. Steel buffer springs protect the base from injury in case of careless handling. The steam pipe is led to the cylinder in the center of the back of the valve chamber, allowing cranes to swing close to the hammer from either side.

Simplicity and durable construction are features of the valve which is so designed as to afford the operator accurate control of the hammer at all times. Arrangement is made for lost motion due to wear to be taken up by gravity. This hammer is double acting, taking steam above and below the piston, and any variation of blow may be obtained. The general rigid construction of the frame and flanged, cross-webbed base plates which are cast in one piece is evident. The guides are hung in pockets planed in the frame, the weight of the guide being carried by a lug solid on the guide which fits in a corresponding recess in the guide pocket, thus taking the weight from the bolt. This arrangement locks the adjustment and relieves the strain on the frame. Adjustment for wear is made by a steel taper shoe which bears the full width and length of the guide and adjusts the guide equally top and bottom, preventing the ram from cocking in the guides. The piston rod is made solid with the piston, a safety pin being provided to give warning should the rod come loose. Piston rings may be examined without removing the rod from the ram.

A feature of particular importance in connection with the anvil is the fact that the anvil cap may be removed and the anvil die put in its place for upsetting high work. The anvil and anvil cap are of cast-iron unless otherwise specified. An efficient oil pump supplies oil to the valves and cylinder. Steam and exhaust nipples with stuffing box joints are furnished with each hammer. All hammers operate equally well with compressed air or steam.

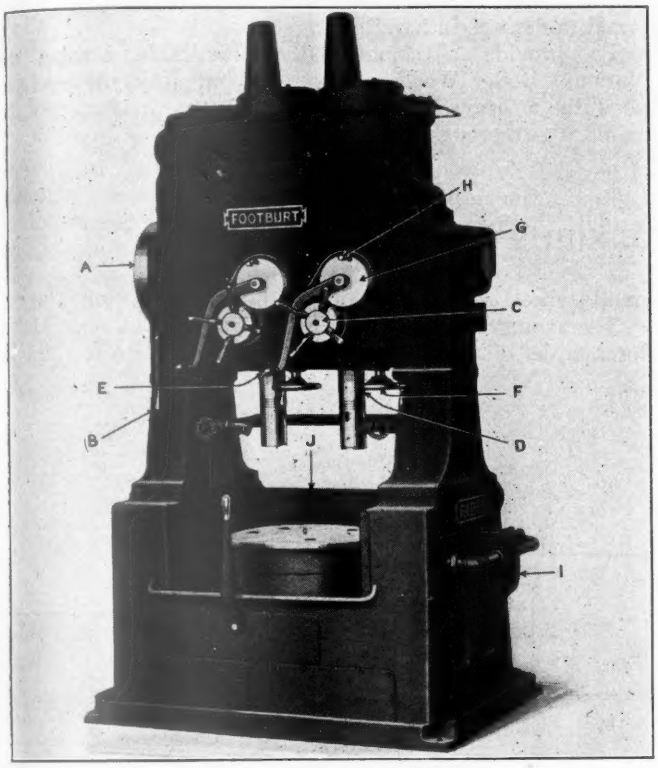
Chambersburg 3,300-Lb. Steam Hammer Adapted to the Varied Demands of Railroad Blacksmith Shop Work

Two-Spindle High-Duty Drilling Machine

AN interesting two-spindle high-duty drill design has been developed by the Foote-Burt Company, Cleveland, Ohio, as illustrated. The frame is constructed with a view to giving maximum strength and rigidity. Between the base unit and the head unit, pedestals of different heights can be inserted at either side, the use of suitable pedestals making it possible to bring the spindle nose as close as possible to the lower face of the head unit for the general character of the jobs on which the machine is to be used. Rigidity is obtained by the use of heavy and properly ribbed sections of cast-iron and by the use of four heavy 2-in. bolts, extending from the bottom to the top to tie the whole machine together. Drilling machines of this type are built in Nos. 101 and 103 sizes which cover practically the full

range of capacities required for miscellaneous drilling work.

This two-spindle machine can be used for simply drilling holes, or it may be employed for the performance of such successive operations as drilling and counterboring, drilling and reaming, etc. When two similar operations are performed, a two-station fixture is mounted on the work table.



High-Duty Drill Embodying Important New Features of Design

This enables two pieces of work in one fixture to be under the two spindles of the machine, and while the holes are being drilled in these two parts, finished pieces will be removed from the other fixture and new pieces of work set up in their place. In such a case, the work table will be indexed 180 deg. at each movement. Where successive operations, like drilling and counterboring or drilling and reaming, are being performed, a three-station fixture is used. Such a fixture is indexed 120 deg. at each movement, the work being set up at one fixture station, while the first operation is progressing at the second station and the final operation at the third station. The large hand lever at the front of the base of the machine provides for engaging or disengaging the lock bolt which secures the table in the specified position.

The speed and feed mechanism for the two spindles is arranged in such a way that they are entirely independent of each other. Power is provided by a single pulley *A*, which is furnished with a friction clutch operated by lever *B*. From the pulley shaft, motion is carried through two sets of forged steel bevel gears to two vertical auxiliary shafts, one of which serves each of the two spindles on the machine.

Standard gears are provided in sets to furnish spindle speeds from 43 to 304 r.p.m. and through the use of special ratios, it would be feasible to obtain spindle speeds up to 500 r.p.m. This drill is well adapted for long runs in production work, but on the other hand, it possesses ample flexibility to adapt it for a wide range of operations, and it is intended for such use rather than for the performance of a particular line of work.

The feed mechanism affords a range of feeds from .006 in. to .168 in. per revolution. In addition to the power feed, hand feed may be obtained by either of two ways. On the worm shaft that carries movement to the feed mechanism, there is a positive jaw clutch which may be engaged or disengaged by lever *E*. By disengaging this clutch, feed may be obtained by turning hand wheel *F*, or if it is desired to obtain a quick traverse movement of the spindle, this is accomplished by pulling forward the handles or any one handle of capstan wheel *C* which releases the clutch on the worm wheel and enables direct hand movement through the pinions to the rack teeth on the spindle.

In addition to the clutch control, disc *G* is geared to the feed movement, so that it revolves at the same rate as the pinions. On the disc there is a knockout plug which can be set in contact with lever *E* and trip the clutch at any predetermined point.

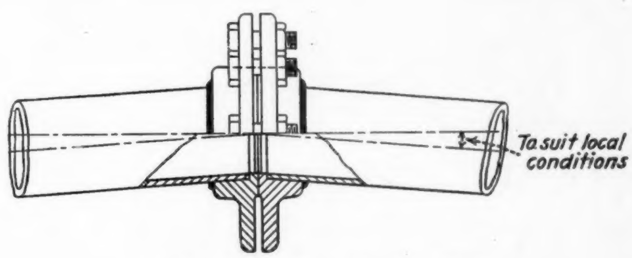
This Foote-Burt drilling machine is intended for use under severe conditions of operation. The designers have provided for the delivery of a copious flow of coolant to the work; the centrifugal pump used has a capacity of 45 gal. of fluid a minute, supplied to the work through a pipe 1¼ in. in diameter. One strainer is provided in the pipe line as shown at *I*, and guard *J* at the back of the work table in conjunction with a similar removable guard at the front prevents the coolant from spattering on the floor while the machine is in operation.

Life of Boiler Washing Plants Increased

THE rapid deterioration of enginehouse piping has been the cause of excessive maintenance costs for boiler washing plants. By the development of a so-called leadizing process of coating roundhouse piping, after the pipe is fabricated ready for installation, with a lead surface of sufficient thickness to withstand the abrasion due to ordinary handling and by substituting drop forged flanges shrunk and welded on the pipes, for threaded connections, the National Boiler Washing Company, Chicago, has overcome much of this excessive cost of maintenance.

The greatly increased permanency of the enginehouse piping thus provided makes practicable an initial installation of hot water boiler washing and filling equipment with mains of sufficient size to permit the future installation of additional capacity at comparatively small expense. The development of the tandem condenser permits the installation of additional condenser units as they may be needed to increase the number of locomotives that can be handled at one time, the additional storage capacity being provided by increasing the number of tanks up to the capacity of the mains.

Prior to the development of the leadizing process the greatest difficulty from corrosion was found to develop at the threaded connections. In order to eliminate this weak



Special Welded Drop-Forged Flange

point and to overcome the additional weakness caused by bending the pipes to conform to the circle of the enginehouse the drop forged flange connections shown in the drawing were developed to replace the threaded connections. With these

connections the roundhouse mains are laid out in the form of chords of the circle of the house and the flanges bored out at an angle varying from the axis by an amount sufficient to bring the faces of the adjoining flanges together, with the adjoining sections of pipe located normal to the center lines of the stalls. The flanges, thus bored, are shrunk and welded to the pipe, which has been cut to length, and the faces of the flanges are then accurately ground to the correct angle in a machine especially developed for the purpose. Since the development of the leadizing process on a commercial basis the sections of pipe thus fabricated are further protected by the addition of a strong lead coating.

The leadizing process was first developed on the Atchison, Topeka & Santa Fe about seven years ago. It consisted in immersing the pipes or other steel to be coated in a hot bath of acetate of lead. The resulting chemical action causes the transfer of lead to the surface and iron to the bath, the action continuing only so long as any of the steel surface is exposed. The lead coating is therefore extremely thin and easily subjected to damage in handling.

To provide a commercially practicable coating the National Boiler Washing Company completes the lead deposit by a heavy electro plating process. After this the material is thoroughly washed and painted.

Unusual Applications of Franklin Automatic Wedges

In the design of automatic driving box wedges, as usually applied by the Franklin Railway Supply Company, New York, the spring operates directly on the wedge bolt and is placed underneath the pedestal binder. There are, however, many locomotives with small-sized driving wheels where the clearance between the binder and the rail is not sufficient to permit such an application. There also are a considerable number of locomotives having thimble binders which make it impossible to employ the standard spring arrangement. In such cases as well as in some others it is necessary to resort to special spring arrangements to take care of the peculiar conditions. A few of the unique designs of automatic driving box wedges that have been made recently to meet unusual locomotive conditions are shown in the illustrations.

The arrangement shown in Fig. 1 is one that has been used on a number of small 10-wheel locomotives having pedestal binders of the thimble type. As will be noted, a lever has been introduced between the wedge and the operating spring. One end of the lever is forked in order to straddle the frame and engage with slots on extended lips added to the wedge. The lever and fulcrum pin of the spring bolt are carried on a cast fulcrum bracket which is bolted to the frame, being held by three bolts. The bolts are located just beneath the lower rail of the frame and thus do not weaken it. On other locomotives a boss for the lever fulcrum pin has been welded to the frame. Where more convenient, the spring bolt may be forked and straddle the lower rail of the frame with the spring bolt fulcrum pin carried in a bracket held by the cross-tie bolts. Arrangements of this kind dispense with additions below the frame and thus are suitable for engines with small wheels or those having underhung spring rigging.

The arrangement shown in Fig. 2 was used on some Mallet locomotives of the 0-8-8-0 type on the Bingham & Garfield.

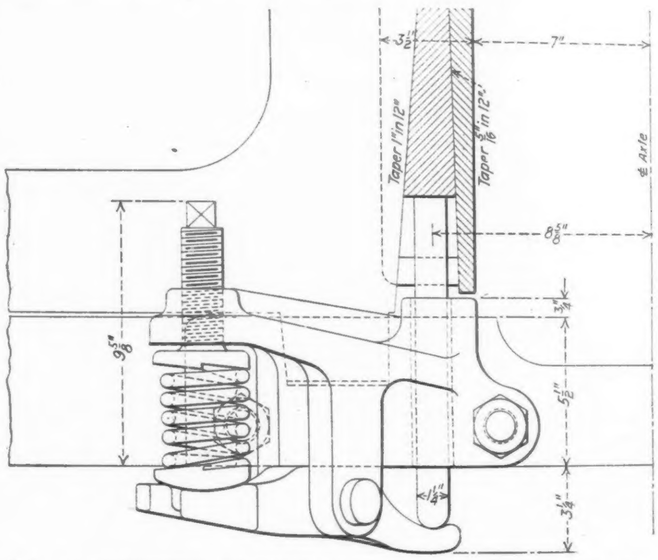


Fig. 2—Arrangement on Mallet Type Locomotives of the Bingham & Garfield

In this case the space occupied underneath the frame was reduced to a minimum by the introduction of a lever and a rail clearance of from 6⅛ in. to 6⅜ in. was thus secured. The

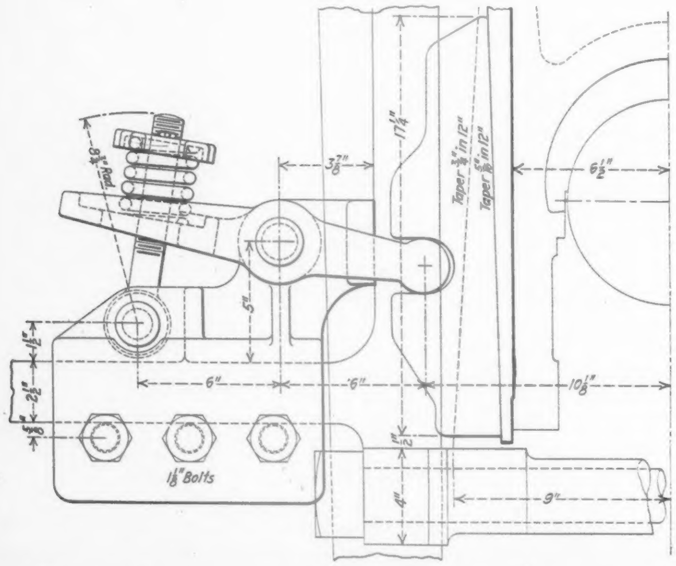


Fig. 1—Arrangement on Locomotives with Small Wheels or Underhung Spring Rigging with Thimble Binders

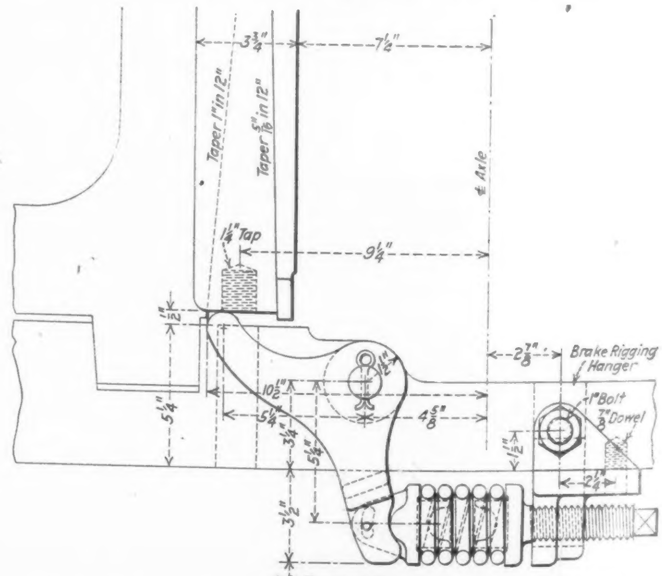


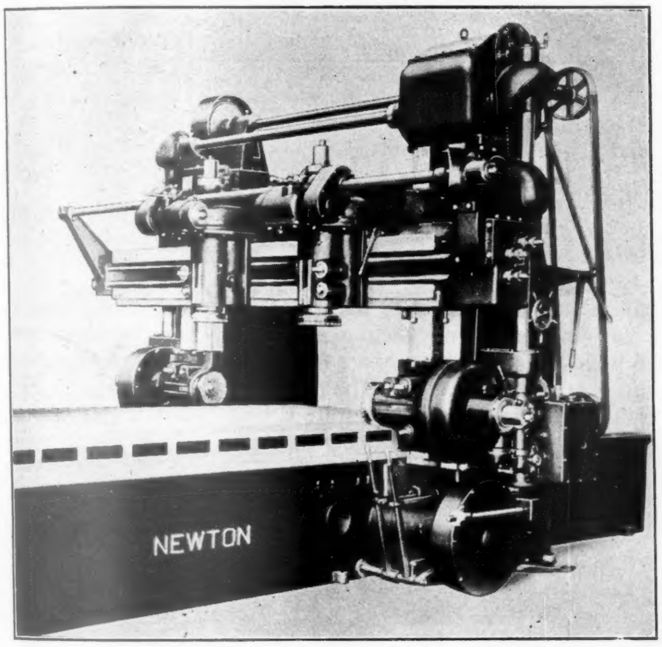
Fig. 3—Bellcrank Lever and Horizontal Adjusting Spring Give Ample Rail Clearance

bracket is fastened to the 5½ in. wide frame by two bolts and the lever is placed at an angle of 45 deg. with the frame, thereby obtaining sufficient clearance for the spring and locating the spring adjusting screw in an accessible position.

Fig. 3 shows a novel method employed to obtain the necessary rail clearance. In this case the adjusting spring is placed horizontally just beneath the frame and a bell crank lever used to transmit the spring pressure to the wedge.

Heavy Planer-Type Milling Machines

A NEW series of planer-type milling machines has recently been added to the heavy-duty milling machines made at the Newton Works of the Consolidated Machine Tool Corporation, New York. They are designed to meet present day demands for high-production machinery in locomotive building and repair shops as well as other large manufacturing plants. The machines, known as Multi-Millers, are rigidly constructed and provided with a wide range of feeds and table speeds adapting them to both light and heavy-duty milling. Control levers are located on both sides of the machine in front of the housings so that the operator has complete control from the side which is most convenient.



Planer-Type Miller with Four Heavy-Duty Milling Heads

The bed is of one-piece box construction with closed top to meet safety requirements. It has an internal gib which clamps the table firmly to the bed when feeding the saddles holding the vertical heads along the cross-rail. The uprights are bolted to the sides of the bed and have a 42-in. bearing on each side. The table is of the double plate construction with a total thickness of 8 in. over the ways and each way provides a bearing 7 in. wide. When the machine is equipped with cutter lubrication system, the table is fitted with shields and is arranged to handle lubricant in large volume.

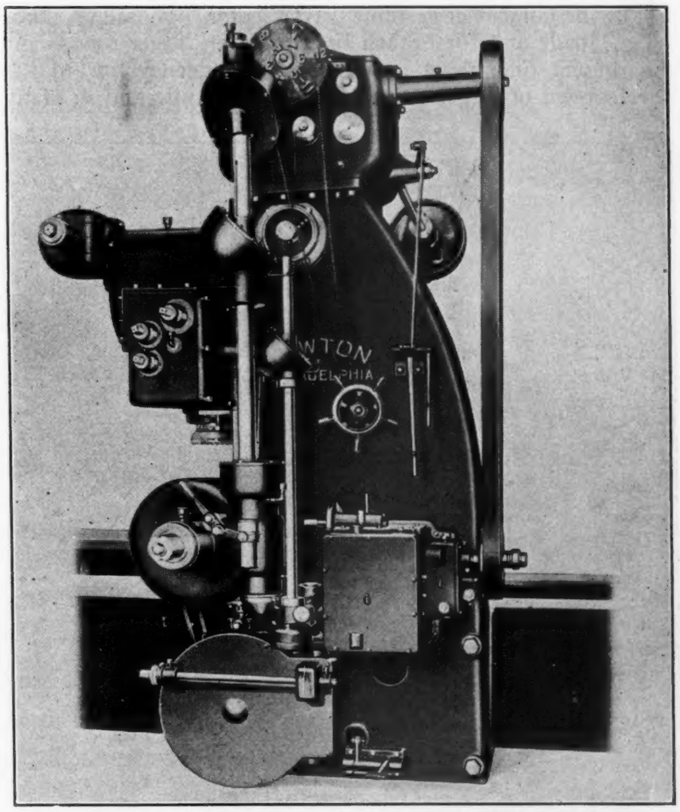
The table rack is of fine pitch and has a face 6 in. wide. Power rapid traverse is provided and moves the table at the rate of 12 ft. per min. in both directions. Hand adjustment is also provided. The table length is sufficient to allow a 12-in. cutter to clear the work at both ends when the table has traveled through a distance equal to the rated length of the machine. The table feeds are entirely independent of the spindle speeds. They are 18 in number and range from 1 in. to 33 in. per min.

The housings are of box section bolted and doweled to the sides of the bed, being reinforced at the top by a heavily-ribbed tie-beam 18 in. deep. The housings are of liberal proportions insuring rigidity and accuracy of alinement under the heaviest cuts.

The cross-rail is a one-piece casting with a 16-in. face. It is strengthened vertically and horizontally according to the width of the machine.

The cross-rail counterweights are contained within the housings and the cross-rail can be raised and lowered by power rapid traverse in both directions at the rate of 3 ft. per min. Hand adjustment, controlled from the end, enables the rail to be moved ⅛ in. per turn of the crank. The cross-rail is clamped to the inner and outer faces of both housings through cam-actuated clamps controlled from the front of the machine.

The saddles for vertical spindle on cross-rail are independent of each other, though feed and rapid traverse are taken from the same shaft. Each saddle has hand adjustment, feed and rapid traverse in both directions on the cross-rail, with provision for clamping by wedge action, when table feed is being used. Feed for each head is engaged or disengaged from the end of the cross-rail. It ranges from ½ in. to 16½ in. per min. The saddles for horizontal spindles are separately counter-weighted and independently controlled, and are arranged so that they can be bolted to the under side of the cross rail when desired.



View Showing Controls and Powerful Spindle Driving Mechanism

The spindles are made from solid steel forgings and are of taper end construction with Morse taper hole, face keyway and draw-in bolt. They are hardened and finished ground on dead centers; run in bronze bushings and are fitted either with Ames dials or scales as desired.

The main drive is by a phosphor bronze worm wheel which

is bolted to a hub carried in a bearing separate from the spindle; thereby relieving the spindle of torsional thrusts. On each head there is provision for disengaging the spindle so that it does not operate except when its service is required. All gears in the driving and feed train are either of hardened steel or phosphor bronze, except the table rack and large diameter table gear, which are cast-iron. All driving and feed gearing are enclosed to run in oil, the gears being enclosed for safety by built-in methods rather than by arrangement of loose covers such as are frequently employed.

The machines can be arranged for belt or motor drive through a friction clutch pulley mounted on top of the left upright, the power being transmitted through a horizontal shaft to a 12-speed gear box mounted on the right-hand upright. The motor is belted to the main pulley and can be mounted on the floor, wall or ceiling as preferred. The type of drive tends to eliminate vibration in the machine due to the high speed of the motor.

Clark Pressure Retaining Valves

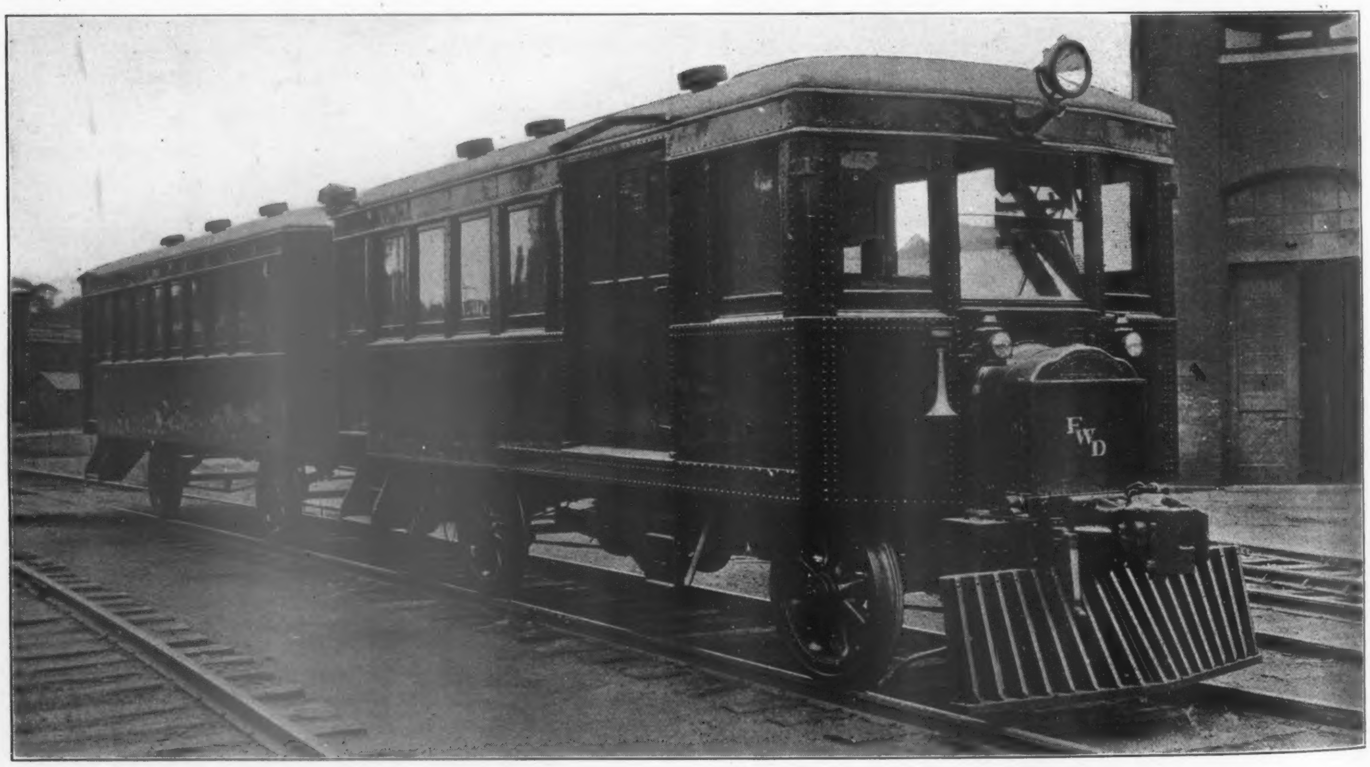
THE Clark Company, West Pittston, Pa., has now designed complete pressure retaining valves of both the single and the double pressure types. These contain the Clark valve of rubber composition which was designed originally as a substitute for the weighted valve in the older type of retainers.

The plug cock used in other pressure retaining valves has been dispensed with and in its place a camshaft has been mounted in the top of the case. This cam, dependent upon its position as determined by an attached lever handle, either permits the valve to lift and allow the exhaust from the triple valve to escape to the atmosphere without obstruction or exerts a certain pressure on top of the stem attached to the rubber valve and thus determines the amount of air pressure retained in the brake cylinder. In the single pressure retainer there are two positions for the cam shaft handle and three positions for the double pressure retainer. The possibility of leakage past a plug cock is obviated by this construction.

A still further modification consists in the use of a single attaching lug at the top of the valve. With this form, a pipe clamp is used below the valve.

Four-Wheel Drive Motor Car and Trailer

THE past year has seen a slow but steady increase in the number of gasoline driven motor cars used on small roads and for branch line traffic on larger roads. At the present time there is a noticeable tendency toward the development of larger and more powerful units and in many cases increased flexibility is attained by the use of a trailer, a sufficiently powerful engine to drive the two cars being used for the motor car.

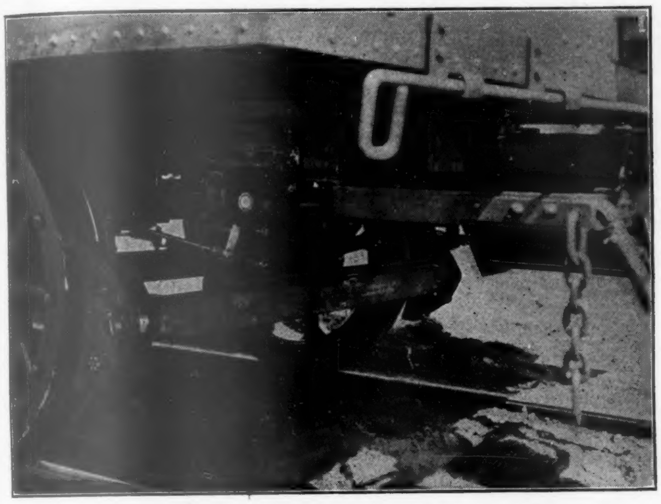


Two-Unit Train on Hoosac Tunnel & Wilmington Accommodates 44 Passengers and Baggage

The Four-Wheel Drive Auto Company, Clintonville, Wis., has furnished recently to the Hoosac Tunnel & Wilmington a two-unit train in which a number of improvements have been embodied. The cars are of steel construction throughout and neat in appearance. The motor car is 25 ft. 5½ in. long from center to center of couplings and has a wheel base of 15 ft. 5 in. The trailer car is 27 ft. 5 in. long from center to center of couplings and has the same wheel base as the motor car. The body of the motor car is 21 ft. 7 in. long and that of the trailer 25 ft. 6½ in. The motor car has seats

for 15 passengers and an 80 sq. ft. space for carrying 2,000 lb. of baggage or express matter. The motor car complete with body weighs 18,000 lb. or 11,000 lb. for the chassis without body. The trailer car weighs 16,000 lb. complete with body or 6,300 lb. for the chassis alone and seats 40 passengers. The great importance of a minimum light weight of car per passenger carried evidently has been kept in mind for the car weight is only 617 lb. per passenger seated.

Power is furnished by a 6-cylinder Wisconsin engine having cylinders 5.1 in. in diameter and 5.5 in. stroke. The horsepower is 62 hp. S. A. E. rating and 94 hp. developed on brake test. The equipment includes a Stromberg plain-tube carburetor, an Eismann high tension magneto and a 30 gal. gasoline tank. Gasoline is fed by pressure, the air pressure being supplied by a reducing valve connected to the air brake system.



Air Brakes with Well Designed Brake Rigging Are Used on These Cars

The car is driven by all four wheels. Transmission is by means of a jaw clutch, the gears being always in mesh. Four speeds forward and four speeds in reverse are provided. The axles are rigid and of the full floating type. The wheels are 35 in. in diameter, of cast steel and fitted with rolled steel tires.

Considerable attention has been given to the spring suspension to provide easy riding and at the same time take care of lateral sway. The springs are 54 in. long, 2½ in. wide and made of chrome-silicon-manganese steel, heat treated. The four springs are connected to the chassis frame with double spring shackles which permit the chassis to swing sidewise slightly, thus cushioning the side impacts against the rail. The spring arrangement may be seen in the illustration of the chassis and also in the view of the brake rigging underneath the car.

In equipment and furnishings the two cars are complete and modern. Drinking water and toilet facilities are provided. A. R. A. couplers are fitted. Heating is secured by passing the exhaust gases through a system of piping, although a hot water system may be substituted if preferred. Seats are of full size, the same as used in steam passenger coaches. Electric lights are used for illumination and headlight.

Air brakes of the Westinghouse semi-automatic type are provided. The air compressor of 10 cu. ft. per minute capacity is mechanically driven from the rear of the transmission and is controlled by an automatic governor. The semi-automatic brake is a two-pipe system similar to that used on electric surface cars where motor and trailer cars are operated. Operator's valve, application valves, emergency valves, etc., are included. Cast iron brake shoes, one per wheel, are of the same type used in steam service. The manner in which the brake rigging is suspended is clearly shown in one of the illustrations.

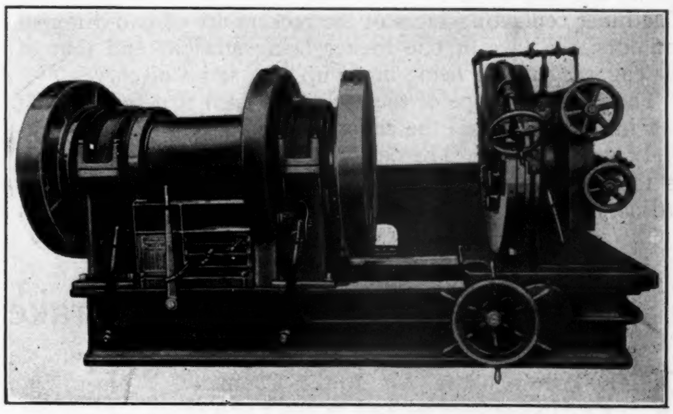
Pipe Threading and Cutting Machine

The Landis Machine Company, Waynesboro, Pa., has added to its line of pipe threading and cutting machines an 18 in. size. The range of this machine is from 8 in. to 18 in. and this entire range is covered by one die head and one set of chasers. The machine, which is about 12 ft. long by 6 ft. wide, weighs 22,000 lb. It has a single pulley drive and the variations in speeds, eight in number, are obtained by means of a speed box located beneath the main spindle. A friction clutch is mounted on the main drive shaft with the pulley. The operating cone of the clutch is moved by two levers which are located at the ends of the head stock within easy reach of the operator. The forward lever is used when threading pipe, while the lever at the rear end of the machine is used for starting and stopping when making up flanges. The lever in the middle is for reversing.

All gears are fully enclosed and, with the exception of the main driving gear and its pinion, run in an oil bath. The main bearings of the hollow spindle are lubricated with flat link chains which run in oil contained in large reservoirs in the base. The driving pinion shaft as well as the reverse shafts are lubricated by sight feed oilers.

At each end of the hollow spindle there is a three-jaw independent chuck for holding the pipe. The rear chuck is equipped with flange grips for fitting flanges.

The carriage which supports the die head, the cutting off tool, and the reaming tool are moved either by power or by hand. The power traverse or movement is both forward and backward and is controlled by a lever located on the operating side of the carriage. In advancing the carriage toward the chuck, the lever is pulled and held until the threading position for the die is reached. In reversing the movement of the carriage, the lever is pushed forward and held. Releasing the lever stops the carriage at any point within its travel.



Landis 8-in. to 18-in. Pipe Threading Machine

Automatic stops prevent the die head from coming in contact with the chuck in the forward movement and the carriage

from running off the guides of the machine in the backward movement. The reaming tool is quickly set to position and locked with a lever.

The machine is converted to motor drive by replacing the pulley with a sprocket and mounting the motor on a base over the gear box. A silent chain is employed to drive from the motor to the sprocket. The Landis long life tangential chaser is used with this machine.

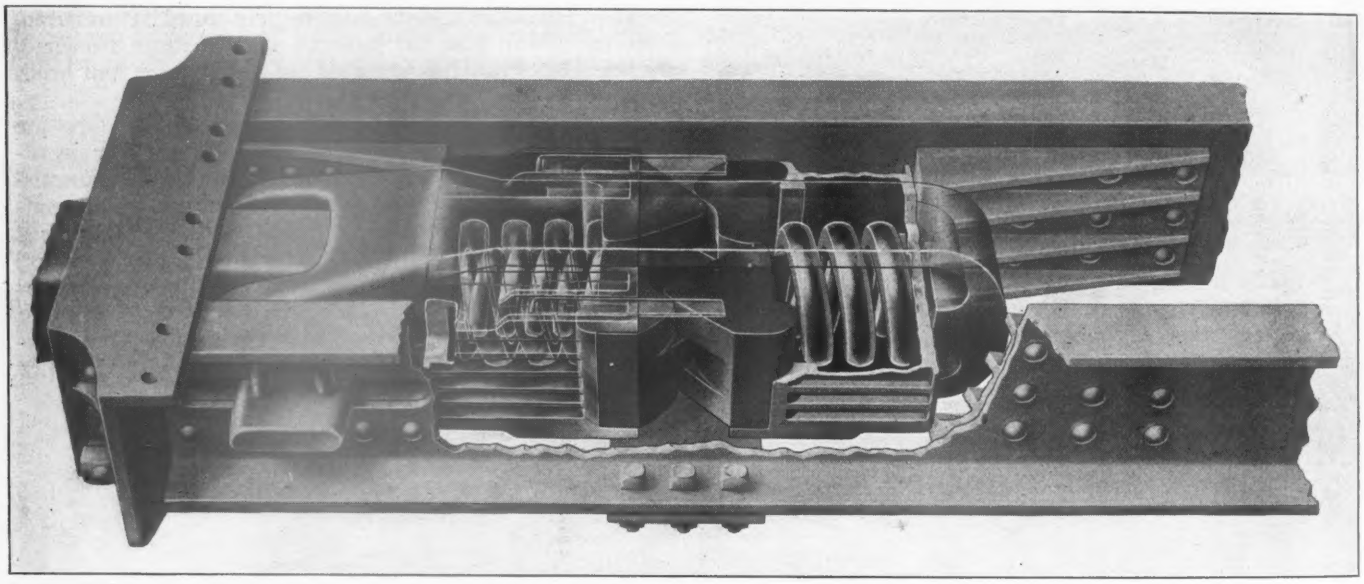
Bradford Rocker Type Draft Gear

THE Bradford Draft Gear Company, New York, without departing from the principle or general design of the rocker type draft gear, has materially increased its strength and shock-absorbing capacity. In its present form this gear has a capacity of 500,000 lb. and can be designed for a travel up to 2¾ in.

The Bradford rocker type draft gear, as will be noted from the illustration, consists of two cast-steel spring housings, two pairs of interacting steel rockers, two sets of special springs and two spring plates between the springs and the rockers. All parts are held together for shipment and application by 1 in. by ⅛ in. band iron hooks.

point, there is but little wear under normal operating conditions. The fact that the gear is assembled under initial compression insures that whatever wear may occur will have little effect on the capacity. Should the parts wear an amount equal to ¼ in. coupler travel, this would merely reduce the initial resistance of the gear from 12,000 lb. to 8,000 lb.

During the last half of the travel, the contour of the rockers increases the effective spring pressure and the friction builds up rapidly so that an ultimate capacity of 500,000 lb. is obtained. The injurious effect of unusually severe shocks occasionally encountered in service is thus guarded against.



High Capacity Bradford Rocker Type Draft Gear

One end of each rocker rotates on a cylindrical seat in the spring housing while the other end bears on the spring plate. The inner contacting faces of the rockers are of two different contours, the face of one rocker being straight and that of the engaging rocker being made up of a series of curves.

The peculiar shape of the rockers is such that for the first 1⅜ in. of gear travel the action of the rockers is almost entirely a rolling one. The performance is practically the same as that of a plain spring gear. As the shocks received in ordinary service would not compress the gear beyond this

The initial leverage ratio of the gear is about 1-⅜ to 1 and this is but slightly increased at 1-⅜ in. travel. At full travel it becomes over 3 to 1.

An important feature of the improved gear lies in the 50,000 lb. capacity springs now employed. These springs, in addition to being made of special steel and carefully heat treated, are of a peculiar section as will be noted from the illustration. The flat faces are of great value in preventing injury to the springs should the gear be compressed solid under unusually severe shock.

Wabco Gaskets for Brake Cylinder Pressure Heads

THE Westinghouse Air Brake Company, Wilmerding, Pa., has developed and recently placed on the market a new brake cylinder pressure head gasket, called the "Wabco." These gaskets are made of the same materials as enter into the construction of Wabco packing cups which have been in general service for some time.

A tough, oil-proof and heat-proof composition is used in combination with an open-mesh, heavy cord fabric. The fabric, around and through which the composition is moulded, serves as a skeleton framework to give stamina to the gasket. It is not as limp as the ordinary rubber gasket and the work of applying it to the brake cylinder consequently is considerably facilitated.

The special composition employed is of such character that it will not disintegrate even after long service under conditions which would cause the ordinary rubber gasket to break down. Because of the fact that they remain intact when removed from the cylinders at the cleaning period, Wabco gas-

kets can be reapplied, which is rarely possible when a rubber gasket is used. These gaskets do not lose their life when subjected to high cylinder temperatures, therefore they are especially valuable for use in driver brake cylinders which often are so located that they receive considerable heat from the boiler of the locomotive.

American Car Door Operating Device

THE car door fixtures made by the American Car Door Company, Michigan City, Ind., are used in connection with sliding doors for box cars and consist of the complete door hardware, including roller track, hangers, rollers,

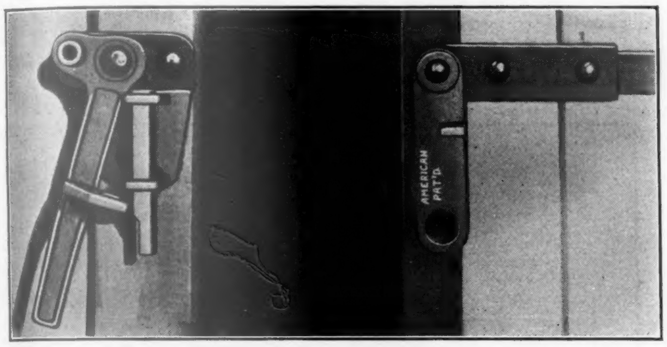


Fig. 1—American Car Door Operating Device in Disengaged Position

front lips, rear stops, bottom guides, burglar-proof guides, steel binding, American flexible protection strip and the American door operating device.

The principal feature of these fixtures is the door operat-

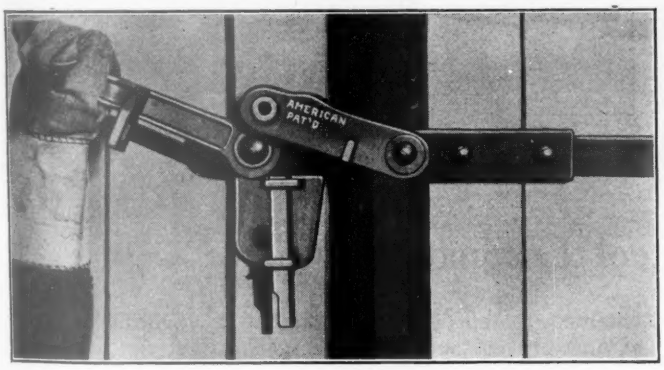


Fig. 2—A Powerful Force is Available for Opening or Closing the Door

ing device which is a door starter, closer and sealing arrangement combined into one unit. The purpose of this device is to afford a mechanical means to force the door open or to pull it closed which will prevent the necessity of prying or sledging at the door to start it open or completely to close it.

Power to open or close the door is obtained by the use of a bell-crank lever located on the door post and the connecting link attached to the sliding door. The door travel of 2½ in. is secured with a lever ratio of 5 to 1.

In the closed and locked position the connecting link is engaged with a protruding lug on the bell-crank lever and is in a horizontal position. A seal-pin is provided which is in front of the connecting link and is free to be raised and lowered within the limits of the two lugs in the bracket. The seal-pin is retained within these two lugs by the heads of a rivet which passes through the central portion of the seal-pin. The handle of the lever is in a vertical position and is provided with a slotted lug which the lower portion of the seal-pin passes through, locking it in place. The upper projecting portion of the seal-pin, which is forward of the

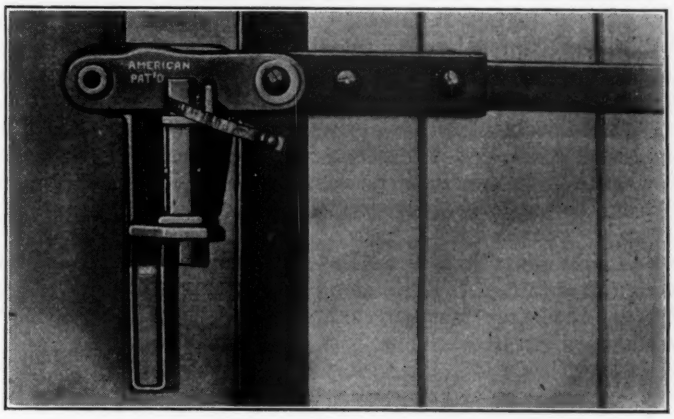


Fig. 3—Door Locked and Car Sealed

connecting link, locks it in position and it cannot be disengaged from the lug on the lever without first raising the seal-pin to disengage the lever and then dropping the seal-pin to its low position.

The seal passes through the upper portion of the seal-pin and the slotted lug on the connecting link, making it impossible to operate the device or to gain entrance to the car without destroying the seal.

When the car door is open all parts of this device are clear of the door opening and do not project or obstruct the door opening.

Air Compressor Exhaust Disposition and Utilization

FOR a number of years it has been the usual standard practice on most railroads to pipe the exhaust of the locomotive air compressor into the left back exhaust passage of the locomotive cylinder. This has been a convenient point for a connection and the air compressor exhaust was disposed of with little added draft on the fire. The arrangement is not ideal since the back pressure on the air compressor may be considerable should an air compressor exhaust occur at the same instant as that from the back end of the left-hand locomotive cylinder. To overcome this objection and at the same time so dispose of the air compressor exhaust that some real benefit will be derived from it, the Locomotive Lubricator Company, Chicago, has devised an arrangement by which the air compressor exhaust is piped to all four exhaust passages from the main locomotive cylinders. The air compressor exhaust can then, so to speak, take the course of least resistance with a corresponding benefit to the compressor in reduction of back pressure and an increase of capacity and efficiency.

The advantages of this arrangement are not limited to the

air compressor as it provides an excellent drifting device. The air compressor exhaust acts to break the cylinder vacuum formed when the throttle is shut off and the locomotive is drifting down a hill or approaching a station stop and thus avoids the drawing in of front end gases and cinders through the exhaust nozzle.

When a locomotive is drifting is the time when the air compressor is frequently running at more than its average speed. Should the amount of exhaust steam from the air compressor be insufficient, as might occur on roads where there is considerable drifting, the Locomotive Lubricator Company has arranged to provide an auxiliary valve which will automatically admit a certain quantity of live steam to the exhaust passages when the locomotive throttle is closed. This valve is opened by a tappet attached to the throttle lever, but the amount of opening can be easily regulated by the engineer.

As the air compressor exhaust carries with it a certain amount of lubricating oil, the benefit to the valves and cylinders will be even greater than from direct steam. The arrangement is simple and there is practically nothing to get out of order. It is stated that the mileage of valve and cylinder packings has been materially increased and that carbon incrustation has been reduced to a minimum on locomotives equipped with the air compressor exhaust arrangement described.

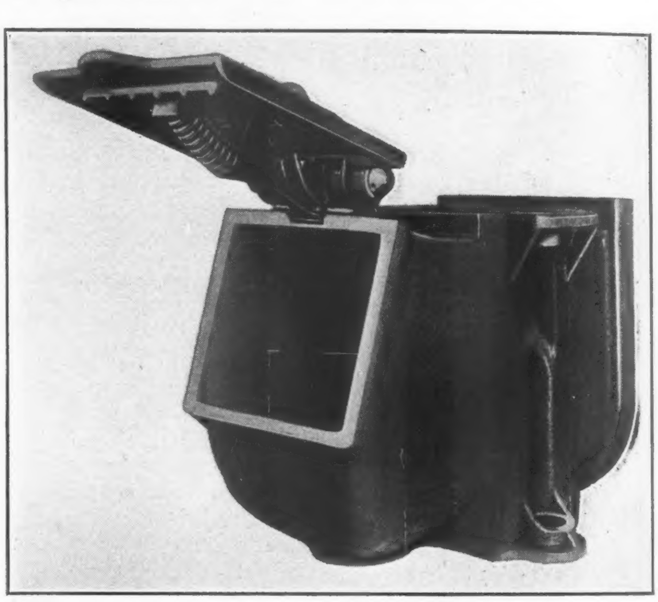
Coiled Spring Lid Journal Box

IMPORTANT improvements in the details of construction have been made recently in the National coiled spring lid journal box manufactured by the National Malleable Castings Company, Cleveland, Ohio.

The face of the box opening in this journal box, as now furnished, is milled to insure a perfect contact with the lid. In accordance with established practice, an accurate surface also is secured on the journal box lids by placing them between two dies in a special drop hammer machine. As a result, a continuous contact between the lid and the face of the box opening is obtained around all sides of the opening and the box is consequently dust proof and oil tight when the lid is closed.

The leverage of the spring fulcrum lever has been increased. This gives a more powerful inward pull on the lid when it is in the closed position and compels the lid to close from an angle of approximately 60 deg. from the box opening.

In the hinge lug, as well as in all other respects, this box conforms to the A. R. A. standard designs and requirements. Should it be necessary, in case of repairs to do so, an A. R. A. standard pressed steel or cast lid with a flat spring can be substituted for the lid with a coiled spring.



National Journal Box with Coiled Spring Lid

High-Test Vanadium Steel Locomotive Frames

THE four new Norfolk & Western electric locomotives which are being built by the American Locomotive Company and the Westinghouse Electric & Manufacturing Company, will have frames of a special high-test vanadium steel supplied by the Union Steel Casting Company, Pittsburgh, Pa. As each of these locomotives consists of two units, a total of sixteen frames will be required, four for each of the four locomotives. These frames are 41 ft. 2 in. long with the main section 6 in. wide and weigh 23,700 lb. each.

The composition used is the result of research work during the past year, this work being carried on by co-operation between the Union Steel Casting Company and the Vanadium Corporation of America.

Table I—Specified Physical Properties

	Standard Vanadium	High-Test Vanadium
Tensile strength, lb. per sq. in.	70,000	80,000
Yield point, lb. per sq. in.	40,000	50,000
Elongation in 2 in.	20 per cent	20 per cent
Reduction in area	35 per cent	40 per cent

The minimum tensile strength and also the yield point of this new high-test steel is 10,000 lb. greater than for the standard vanadium steel. This increase in strength has been obtained, moreover, without sacrificing anything in the way of ductility or toughness, the specification for reduction in area having been raised from 35 per cent to 40 per cent while the elongation in 2 in. has been kept at 20 per cent. A comparison between the physical properties of the two steels is shown in Table I.

The manner in which the physical specifications are being met is shown by the results of eleven tests made on the five heats for the first five frames cast. Instead of giving these tests in detail, the results have been summarized in Table II. The maximum and minimum figures show the ranges for each characteristic.

Table II—Summary of Test Results

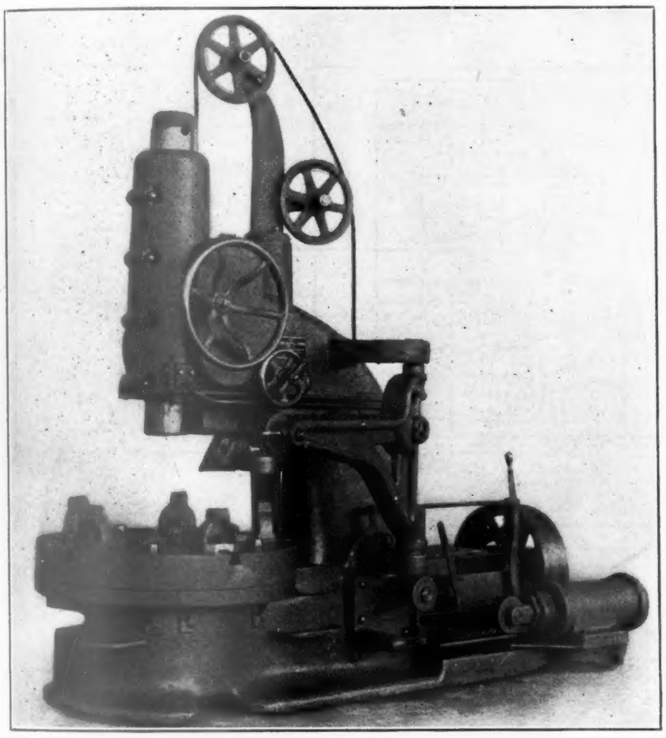
	Yield Point lb. per sq. in.	Tensile Strength lb. per sq. in.	Elongation in 2 In. per cent.	Reduction in Area per cent.
Maximum	57,580	97,120	28.0	54.1
Minimum	48,680	80,880	22.5	39.2
Average	54,550	88,480	24.7	46.6

The Union Steel Casting Company, in conjunction with the Vanadium Corporation of America, has prepared a set of specifications for high-test vanadium cast steel for locomotive frames. In general form the specification agrees with those of the American Society for Testing Materials and the

American Railway Association. In addition to the physical properties already mentioned, the chemical requirements are: Phosphorus or sulphur not over 0.05 per cent, and vanadium not less than 0.16 per cent. The steel is to be made by the open-hearth, or by the electric furnace process. The castings after being allowed to cool are to be heated to the proper temperature to refine the grain. The size of the annealing lugs, the location of the test coupons, the taking of drillings for analysis and the method of conducting the physical tests are all covered. Provisions are made for re-annealing in the event of the first tests failing to meet the specifications. Minor defects which do not impair the strength of the castings may be welded with the approval of the inspector. If this is done, the castings are to be annealed after the welding.

Car Wheel Borer With Air-Operated Chuck

Realizing the vital relation of the wheel-clamping and releasing mechanism in a car wheel borer to efficient operation, the Putnam Machine Works of Manning, Maxwell & Moore, Inc., New York, has brought out a new pneumatic chuck which clamps or releases instantaneously and can be operated as well when the table is running as when it is stationary. A large hole all the way through the spindle allows free passageway for the chips.



Putnam Car Wheel Borer with 5-Jaw Pneumatic Chuck

This machine is also equipped with a pneumatic hoist for lifting the wheels in and out of the chuck. By the manipulation of one valve, convenient to the operator, the movements of the hoist are easily and positively controlled for raising, lowering, or holding the load suspended at any point. With this combination, all the time formerly used in clamping and releasing and a large part of the time hoisting in wheels has been saved.

The hub-facing ram is of large size and is guided at the top by a square tongue insuring a rigid support for the tool, which is set in a sliding head for vertical adjustment of the cut. Hubs may be faced at the same time that the wheel is being bored, or independently as desired. A wide range of feeds is provided for both the facing ram and the boring ram.

The drive is through a gear box, giving four speeds in geometrical progression through sliding gears. These gears are of alloy steel, heat treated and hardened and operate in a bath of oil. A powerful multi-disc friction clutch and brake furnishes a convenient means for starting and stopping the machine.

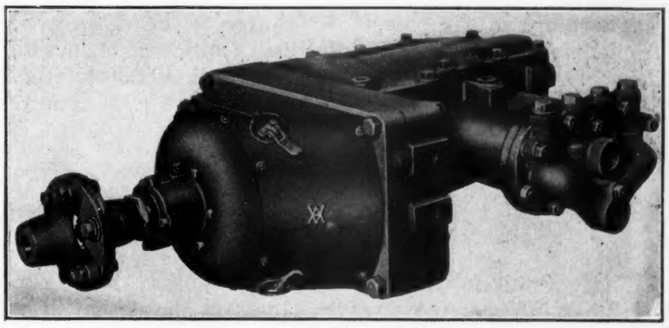
Wheels of from 16 in. to 42 in. diameter can be bored at speeds ranging from 10 to 30 r. p. m. and feeds from 3/64 in. to ½ in. Either single pulley belt drive or motor drive with a 15-hp., 1,200 r.p.m. motor can be provided. The machine is wholly self-contained. Arrangements are made throughout for convenient, and wherever practicable, reservoir or flood lubrication. No gears or other dangerous parts are exposed, full protection for the operator and conformity to safety laws being provided.

Air Brake Equipment for Gasoline-Driven Rail Cars

A new form of air brake equipment has been developed for gasoline-driven rail cars by the Westinghouse Air Brake Company, Wilmerding, Pa. Since this service involves the operation of a single motor car, or at the most a motor car and a trailer, the equipment is of the semi-automatic type.

The source of pressure for the brake system is an air compressor, mechanically driven from the power take-off on the transmission through a pneumatically operated disc clutch. The compressor is single-acting with two cylinders, and because of its low, compact design, is called the "Bungalow" type. Its operation is automatically controlled by a governor of the double safety valve type.

This semi-automatic equipment has all the advantages of a straight air brake equipment in which air is admitted straight from the reservoirs in which it is stored to the brake cylinder through the brake valve and piping during ordinary service brake applications. It is simple, of few parts and flexible; i. e., the pressure in the brake cylinder may be increased or decreased at the will of the operator in accordance with the requirements of condition of rail, grade, loading and kind of stop desired. It also has the safety features of an automatic equipment. During service operations of the brake,



Mechanically Driven Bungalow Type Air Compressor

pressure is maintained in an emergency pipe. Should it be imperative to stop the car in the shortest possible distance to

avoid accident, placing the brake valve handle in emergency position actuates the emergency valve which automatically opens a direct communication between the main reservoirs and the brake cylinder, resulting in a very prompt application. In case of ruptured piping also, the automatic feature operates. The automatic characteristic of this equipment makes it suitable for use on a motor and trailer car train in view of the safety and assurance of an application which are secured in the event of such an emergency as that of a burst hose or a break-in-two.

Symons Double-Vee Friction Draft Gear

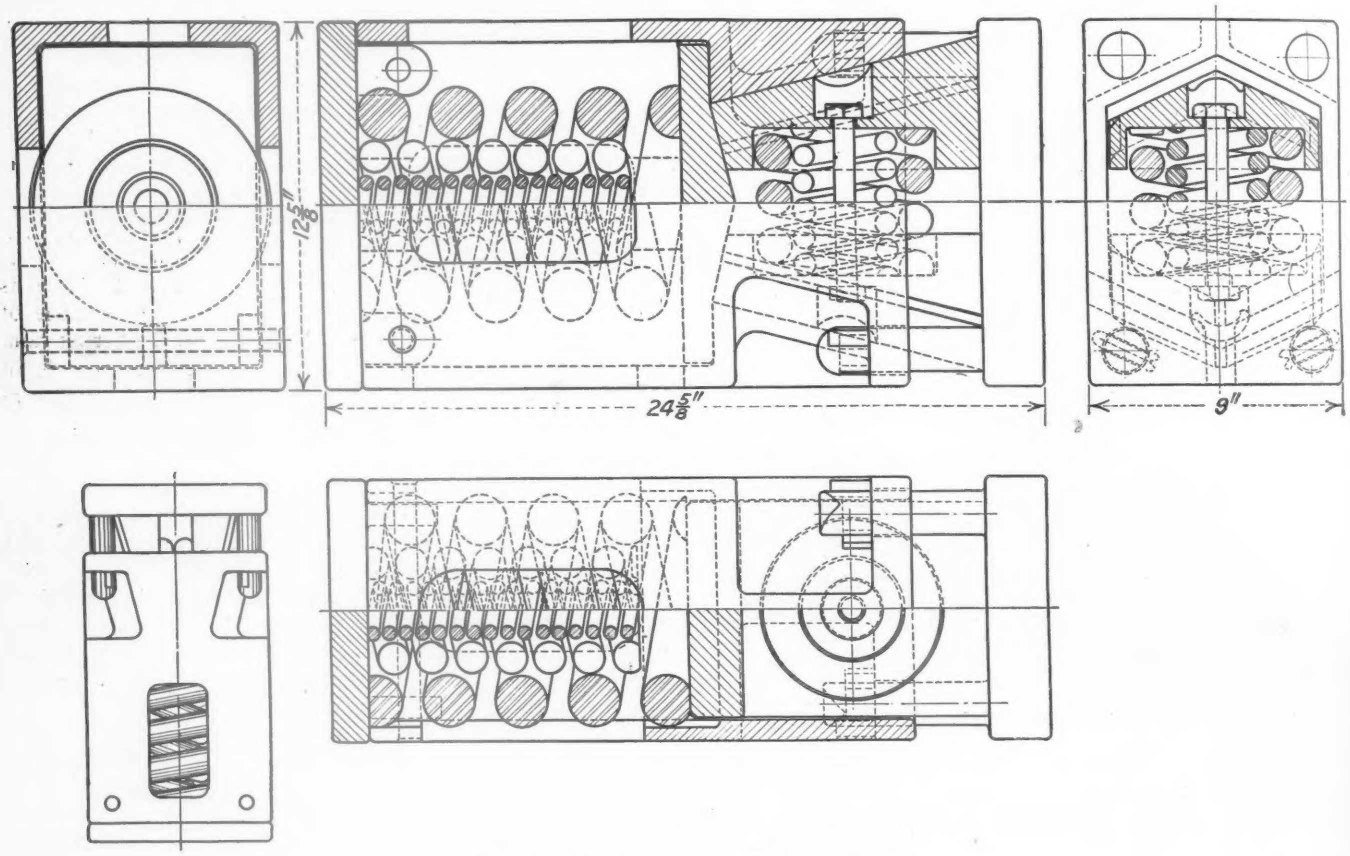
A NEW type of friction draft gear, known as the Double-Vee, is being introduced by the designer, W. E. Symons, New York. As will be noted from the illustrations, this gear is of simple construction and contains but few parts. It consists of a casing, two V-shaped friction wedges, a set of three draft springs, a pair of friction springs, a bolt for holding the friction blocks and springs together, an end casting for the casing, an inside spring seat and a follower.

The name of the gear is descriptive of the shape of the friction faces of the wedges and the casing grooves in which they function. The spring capacity is from 40,000 to 50,000 lb. and the gear travel 2½ in. In a test which was conducted on one of these gears, the following results were obtained:

Travel	Capacity
½ in.	32,000 lb.
1 in.	56,000 lb.
1½ in.	84,000 lb.
2 in.	201,000 lb.
2¼ in.	233,000 lb.
Closing	285,000 lb.

An important feature of this gear is the fact that it is a complete and self-contained unit. All parts, including the follower, are fastened together ready for application. No separate or additional parts are required.

As will be noted from the drawing, the dimensions are such that it can be applied in the standard A. R. A. gear pocket, 9 in. by 12⅝ in. by 24⅝ in.



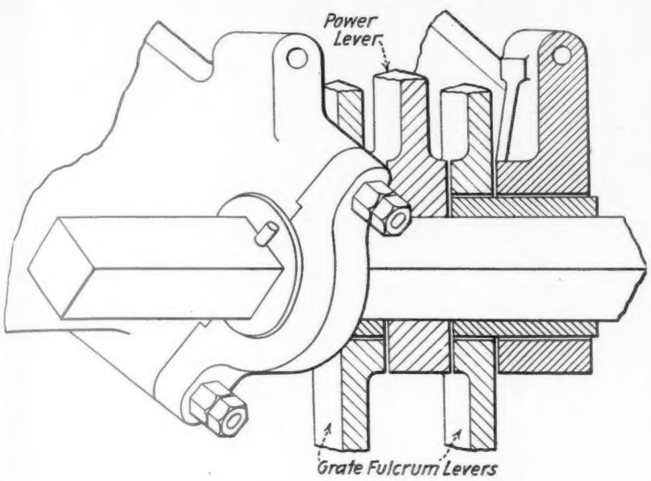
Details of the Symons Friction Draft Gear

Franklin Power Grate Shaker Improvements

THE Franklin Railway Supply Company, New York, has incorporated several changes in the design of the power grate shaker and in the method of connecting it to the grate rigging which has increased the reliability of action, added to the durability and reduced the expense of maintenance.

A full throw of the grates is essential and in order that this may be insured, the number of connections between the grate shaker and the grate rigging should be as few as possible and the pins properly fitted. The best arrangement is secured by fastening the grate shaker cylinders to the back head of the boiler, connecting the two cylinders together with

a square shaft and rigidly attaching the power arms to the shaft instead of fitting them loosely as has been the practice hitherto. In some instances the power arms now are shrunk on the shaft and in other cases they are attached by welding. When the power arms are rigidly fastened to the shaft, it is necessary that the grate lever fulcrum brackets be equipped with split bushings so that the caps are removable to permit the shaft to be taken out. With this new arrangement, which is shown in the illustration, the only points where lost motion may develop are in the connections to the connecting locks and the pins in the ends of the fulcrum levers and the grate bars. The two inside grate fulcrum levers and bushings are of course applied to the shaft before the power levers are attached.



Split Bearings Are Used When the Power Arms Are Rigidly Attached to the Shaft

The control valve has been changed from the poppet type to the slide valve type. This change was made because it has been found that after continued service the poppet valve would wear and permit live steam to blow past the valve into the exhaust port and maintain a back pressure on one end of the cylinder which considerably reduced the power of the shaker. With the slide valve now used, this cannot occur as a free exhaust is maintained at all times. A slide valve is, moreover, much more easily maintained than a poppet valve as it can be reseated easily should a leak occur. With the poppet type valves, when wear developed, it was necessary to bush the valve body and apply a new standard valve in order to secure a proper fit.

Rex Coach Seats of Improved Design

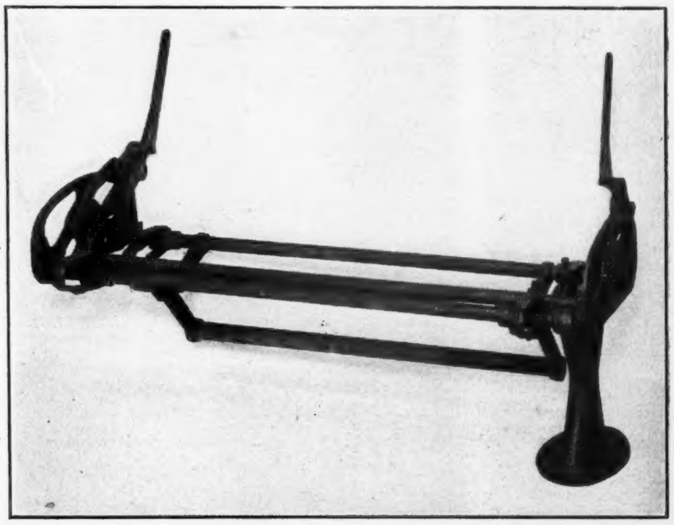
A NEW coach seat of improved design has been brought out by the American Car & Foundry Company, New York. This seat, known as the Rex coach seat, is of simple and rugged construction. The number of individual parts, either fixed or operating, is small and they have been well proportioned to reduce the liability of breakage; the limited number of rivets, bolts and screws has reduced the possibilities of trouble occurring with the seat mechanism. The close tolerances in machining the operating parts eliminates rattle, while the large bearing surfaces reduce the wear and insure long life. All parts are manufactured to standards, making them interchangeable should repairs be necessary.

One Model of the Rex Coach Seat

The reversing mechanism, which is independent of the pedestal or seat end, is of the link type, provided with large pivot bearings and rigidly tied together so that in the reversing operation there is no possibility of one end lagging behind the other and consequently binding and racking the frame of the seat back.

All members subjected to stresses are of rolled or forged steel. The use of pipe for the carrying rails presents a neat and sanitary support for the cushion carrier, as well as a simple and efficient connection for these rails to the mechanism of the end castings.

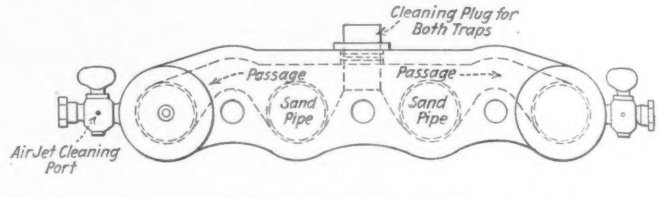
The pedestals, of which several designs in pressed steel or malleable iron are furnished, are independent of the seat rails and other mechanism. The seat ends are of double-wall pressed steel fitted with wood arm rests. Frames for cushion and back are made of either wood or steel. An automatic foot rest is also provided.



The Frame of the Rex Coach Seat Is Simple and Rugged

Watters Double Sander Trap

THE No. 11 double sander trap designed by J. H. Watters, Anniston, Ala., is simple, can be cleaned easily should any obstruction occur and is interchangeable with other types of double sander traps. A single central cleaning plug when removed, permits of the cleaning of either or both portions of the trap. The air jets are located outside of the sander body. The shut-off cocks are counterbored larger at the end entering the sander, thus permitting the air to expand and eliminating the cutting action of the sand blast against the body of the trap. A hole is drilled crosswise through the body of the cock to register with the opening in the plug when it is turned to the closed position. When turned to this position, a small wire can be passed through the cock which will clean out any obstruction that there may be at this point.



The Watters Double Sander Trap Is Arranged for Quick Cleaning of Air Jets and Traps

Powerful 72-Inch Open-Side Planer

MANY improvements have been incorporated in a new open-side planer, made by the Cincinnati Planer Company, Cincinnati, Ohio. Besides having forced lubrication to the vees, which has been the standard on Cincinnati planers for some years, the bearings in the bed are supplied with gravity lubrication. This oil is strained, settled and filtered several times before returning into the bearings. A quantity of this clean oil also cascades over each gear and pinion.

The rail is fastened to the knee which is clamped to the column through two large T-slots. A long slide nut—the length of the bearing of the knee—is placed in the T-slots in place of an ordinary bolt head or short nut, thus insuring a secure clamping surface.

The bed is extremely rigid due to box type construction and of extra depth. This has been done to strengthen the bed through a place where the greatest amount of rigidity is required and also to provide an extra long bearing for the column. The cheeks on the bed are extra heavy, extending considerably above the top of the table and a great distance below the bottom of the bed which provides a greater area for bolting the column onto the bed. Oil pockets are cast integral with the bed of such length to prevent any oil dripping on the floor.

The table, of the standard box type construction, is provided with inner guides which have a bearing the full length of the table. The right-hand side of this table is also provided with a clamp which insures the table against lifting out of the vees when planing work which extends beyond the left-hand side of the machine. The column is thoroughly braced and ribbed on the inside in such a manner that distortion is practically impossible. Besides having the column bolted and dowelled to the bed there is an exceptionally large tongue cast integral with the bed insuring the column against any possible chance of moving.

The rail is equipped with a power-elevating device, the screws which raise and lower the rail being mounted on special heavy ball bearings. The heads are also provided with rapid power traverse in all directions and are equipped with safety crank handles which will prevent accidents when throwing in the rapid traverse. This is so arranged that when engaging the rapid traverse handle, the ordinary crank handle will stand still. There is a limit stop which prevents the rail from raising beyond its maximum height.

All the control levers are within reach of the operator, making it needless for him to move out of his position at any time excepting when setting up work. This machine will plane 72-in. under knee, accommodating work 12 ft. long. The width of the table is 62 in. and the total width of the machine 182 in. The driving motor is rated at 35 hp.

Modern Features of Planer Design Are Included in This 72-In. Open-side Planer

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CUTTING UP STEEL CARS WITH THE ELECTRIC ARC.—In an article on cutting metals with the electric arc, A. M. Candy states that by this process an entire coal car was cut up in four hours' time into pieces sufficiently small to be handled by four men who were shearing the material into smaller pieces. The cost of the arc cutting including labor and power for the motor generator was $6.80. For cutting rivets currents of 400 or 600 amperes are usually used. When using 400 amperes the average operators will cut from 1,800 to 2,000 rivets ⅝ in. in diameter per 10-hr. day and some operators will run as high as 2,600 to 3,100 such rivets when the work is on a piece-rate basis.

GENERAL NEWS

The Utah Supreme Court holds that an employee killed while repairing a locomotive which had been used in interstate commerce before being put in the shop for repairs, which took nearly a month, was not engaged in interstate commerce.—Larkin v. Industrial Commission (Utah) 208 Pac. 500.

The threatened strike of shopmen on the Denver & Rio Grande Western has been averted by Governor Sweet, of Colorado, who proposed that the charges of unfair practices be taken before the District Court at Denver, for settlement. The shopmen agreed to await the decision of the court, which has authority over the road through the receiver.

Atlantic Coast Line Locomotive No. 432, Pacific type, hauled a train of nine cars, carrying members of Egypt Temple Shrine from Tampa, Fla., to Richmond, Va., early in June, a distance of 883 miles, without being detached from the train. The party was en route to the Shriners' conclave at Washington, D. C. Fires were cleaned at intervals of approximately 100 miles.

A special passenger train of a locomotive and seven cars, which left Winnipeg, Man., on July 6 at 8:15 a. m., ran through, over the Canadian Pacific, to Quebec, 1,579 miles, in 36 hours, 12 minutes, equal to 43.6 miles an hour. From Smith's Falls, Ont., to Ballantyne, 121 miles, the time was 118 minutes. The regular time of the fastest train between Winnipeg and Quebec is 53 hours. This special train was run to make connection with a steamship for Europe for passengers who had been delayed west of Winnipeg by a landslide.

From January 1 this year to July 2, a total of 10,217,830 tons of bituminous coal had been unloaded at Lake Erie ports for shipment up the lakes. The Car Service Division of the American Railway Association reports that this is the largest quantity ever dumped during the corresponding period except in 1921 when the total exceeded the total this year by 38,059 tons. During the week which ended on July 2 this year, 21,245 cars were dumped at Lake Erie ports, the largest number of cars reported during any corresponding week except in 1921 when that total was exceeded by 141 cars.

The Mechanical Division of the American Railway Association has four scholarships at Stevens Institute of Technology, Hoboken, N. J., two of which are now vacant. These scholarships are available for the sons of members of the division and cover the regular tuition charges for a four-year course, leading to the degree of Mechanical Engineer (M. E.). The course offered also includes instruction in electrical, civil and other branches of engineering.

Applications for these scholarships should be in the hands of V. R. Hawthorne, secretary, as promptly as possible. In case there are more than two applicants, they will be given to the two passing the entrance examination with the highest standing.

Missouri Car Shed Act Held Unconstitutional

The Federal District Court for the Eastern District of Missouri holds that the "Car Shed Act" is in violation of the state Constitution as being too indefinite and uncertain, and as fixing no ascertainable standard of guilt.—Wabash v. O'Bryan, 285 Fed. 583.

St. Louis-San Francisco Offers Insurance to Employees

The St. Louis-San Francisco has arranged with the Metropolitan Life Insurance Company to issue group insurance to its officers and employees. Those earning $200 a month or less will be permitted to take out $3,000 insurance, of which the railroad will pay 40 per cent of the premium on the first $1,000 and the employee all of the premium on the remainder. Those earning between $200 and $300 a month may take out $4,000, of which the company will pay 40 per cent on the first $2,000. Individuals receiving over $300 a month will be permitted to take $5,000 of insurance, of which the railroad will pay 40 per cent of the premium on the first $3,000. The $2,000 of extra insurance at the low rates offered can be obtained without medical examination, regardless of age or physical condition, provided 75 per cent of the individuals in that class take advantage of the offer. Besides life insurance, payable at death, the policies will carry total disability clauses.

Loss and Damage Reduced Thirty Per Cent

For the two months ended February 28, 1923, the amount charged to loss and damage on the Class I railroads of the United States, was $6,978,716, as compared with $10,042,534 for the same period last year, a decrease of 30.5 per cent. This year's record charges to rough handling 18.4 per cent; to unlocated damage, 14.7 per cent; defective equipment 12.4 per cent; loss of entire package 10.2 per cent and delay 9.1 per cent.

Revision of Car Service Rule No. 14

Car service rule No. 14, regulating emergency transfer of lading from freight cars, has been revised and was adopted August 1 by letter ballot by the transportation division of the American Railway Association so as to require that when the transfer or readjustment of a load is necessary because of the omission of proper inside door protection, the cost of transfer shall be borne by the originating road.

Fuel Conservation on the Missouri Pacific

A general fuel conservation committee, including the general manager, the assistant general manager, the mechanical superintendent, the superintendent of transportation, the superintendent of fuel conservation, the fuel purchasing officer, the assistant chief engineer, the auditor of disbursements and the secretary, has been formed on the Missouri Pacific. The committee will prescribe plans and practices to further economies in fuel purchases, distribution, handling, storage and consumption.

A Sixteen-Thousand Ton Train

The great Northern established a record in hauling ore on June 21 when a train of 16,360 tons was moved by one locomotive to Allouez Dock at Superior. Mallet engine No. 2022 hauled 125 loaded ore cars, from an assembly yard at Kelly Lake to Baden, Minn., a distance of 39 miles, where 25 more loads were added to the train and hauled to Allouez, a further distance of 64 miles. Between Kelly Lake and Baden the train was hauled up a 0.3 grade about three miles long.

Fuel Association Conducts Prize Paper Contest

A prize contest for the best paper on railway fuel conservation, open to enginemen, firemen, conductors, brakemen or switchmen, has been announced by the International Railway Fuel Association. A prize of $100, offered through the association by Eugene McAuliffe, special representative, Union Pacific System, will be awarded to the writer of the best paper submitted, the judges to be M. A. Daly, president of the association; L. G. Plant, mechanical department editor, Railway Review, and C. B. Peck, managing editor, *Railway Mechanical Engineer*. The contest

closes on August 31, at which time all papers must be in the hands of J. B. Hutchison, secretary of the Fuel Association, 6000 South Michigan avenue, Chicago. The Central of Georgia has offered a supplementary prize of $25 to be paid to the winner if an employee of that road. The Southern Pacific offers a free trip to Chicago, with all expenses paid, for the best paper submitted by an employee he to go as the company's representative to the convention next May. A few other railroads have also signified their intention of supplementing the prize offered by the association, with a prize for the best paper submitted by any of their men.

Railway Club of Greenville, Pa., Establishes Magazine

The Railway Club of Greenville, Pa., has established a monthly magazine, Volume I, No. 1, of which is the April issue. The club is entirely the affair of employees, although officers of the Bessemer & Lake Erie and the Greenville Steel Car Company are included in the membership. The proceedings of the club as well as railway matters of general interest will be published in the magazine. Marion B. Richardson, mechanical draughtsman for the B. & L. E., is editor.

Another Remarkable Performance by M-K-T Locomotive No. 411

Locomotive No. 411 of the Missouri-Kansas-Texas, noticed in the July *Railway Mechanical Engineer*, page 542, as running from St. Louis, Mo. to Austin, Tex., 975 miles, without being detached from its train, made another run somewhat similar four days later, June 15, when it took a train of 14 passenger cars from St. Louis to Oklahoma City, 549 miles, on 5,420 gallons of oil. Part of the way there were 15 cars and the total number of car miles was 8,523, making the fuel consumption per car mile 0.63 gallons. The train was taken over the ascending grades between Franklin, Mo. and Sedalia without a helper. This trip, like the former one, was made without detaching the engine from the train.

Wage Increases

The Delaware, Lackawanna & Western has increased the wages of shopmen, beginning on July 1, two cents an hour. First class mechanics heretofore receiving 80 cents an hour will now receive 82. The Louisville & Nashville has made a similar increase.

The Chicago & North Western and the Chicago & Eastern Illinois have increased the pay of shopmen, all classes, two cents an hour.

The New York Central Railroad, following protracted negotiations, announced on July 16 that for shopmen, about 20,000 in number, a general advance in wages of 3 cents an hour had been made, bringing the mechanics' rate up to 73 cents. Tentative agreements were reached between the committee and the management on working conditions, but certain of the revisions in the agreements must first be approved by a referendum vote of the union. Negotiations are now under way on the request for similar increases on other roads in the New York Central System.

The Lehigh Valley has granted the following wage advances to its maintenance of way employees: Track foremen and assistant foremen, $5 a month; foremen and assistant foremen in the bridge and building department, $2.50 to $3.50 a month. Clerical and station employees on this road have received increases of from one to four cents an hour. The following increases have been granted to the shop crafts employees: Machinists two cents an hour, carmen one to two cents an hour, helpers one to two cents an hour, apprentices one cent an hour, helper apprentices one to two cents an hour, car cleaners two cents an hour, stationary engineers, firemen and water tenders two cents an hour.

The Labor Board, in three decisions made public on July 18, ruled that contracts entered into by the Western Maryland with several contracting firms for the operation of its railway shops and for the performance of work formerly done by its signal department and maintenance of way employees, are in violation of the transportation act. The provisions of the contracts affecting the wages and working rules of the workmen were declared to be in violation of the decisions of the Labor Board.

MEETINGS AND CONVENTIONS

Railway General Foremen's Association

The following tentative program has been announced for the 1923 convention at Chicago: September 4—Convention called to order by J. B. Wright, president; invocation, Rev. Robert O. Cooper; address of welcome, Mayor Dever, Chicago; response, J. B. Wright, Hocking Valley; address, Ben W. Hooper, chairman, U. S. Labor Board; response, L. A. North, Illinois Central; president's address, J. B. Wright. September 5—Report of secretary-treasurer, William Hall; appointment of committees; address, James C. Davis, director general of railroads; response, H. T. Cromwell, Baltimore & Ohio; topic No. 1, Shop Efficiency in Locomotive and Car Departments, A. F. A'Hearn and Charles F. Baumann, chairmen; election of officers. September 6—Address, a prominent railroad official; response; topic No. 2, General Repair Methods and Maintenance of Valves, Valve Gears and Power Reverse Gears, F. J. Spanganberger, chairman; topic No. 3, General Repair Methods and Maintenance of Stokers, Coal Pushers and Air Fire Doors, W. S. Buntain, chairman; September 7—Topic No. 4, Shop Kinks, Locomotive and Car Departments, G. H. Logan, chairman; topic No. 5, Welding of Tires, Flanges, etc., H. T. Cromwell, chairman; reports of committees and miscellaneous business; adjournment.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL. V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

DIVISION VI—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 23 West Forty-third St., New York.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual convention November 6-9, Hotel La Salle, Chicago. Exhibit by Railway Electrical Supply Manufacturers' Association.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings, first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Meetings, second Thursday, January to November, Hotel Iroquois, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual meeting Hotel Sherman, Chicago, October 3, 4 and 5.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 6,000 Michigan avenue, Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash St., Winona, Minn. Annual convention, Hotel Sherman, Chicago, September 4-7, 1923.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in each month, except June, July, August and September, Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York, Meeting third Friday of each month except June, July and August at 29 West Thirty-ninth street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings second Thursday in each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in each month, except June, July and August, Fort Pitt Hotel, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Meetings second Friday each month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting, beginning September 11, 1923, Chicago. Exhibit by Railway Equipment Manufacturers' Association.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 605 North Michigan Ave., Chicago. Meetings third Monday in each month, except June, July and August.

SUPPLY TRADE NOTES

The American Steel Foundries are negotiating for the purchase of the Damascus Brake Beam Company.

R. P. Dryer has been appointed district manager of the Whiting Corporation, with headquarters at 624 Penton building, Cleveland, Ohio.

The Latrobe Tool Company, manufacturers of high speed drills and reamers, Latrobe, Pa., has moved its Chicago, Ill., warehouse to 1440 West Lake street.

Manning, Maxwell & Moore, Inc., has removed its offices from 119 West Fortieth street to the Pershing Square building 100 East Forty-second street, New York City.

Percy R. Drenning, formerly with T. H. Symington Company, is now associated with the Boyden Steel Corporation as vice-president, with headquarters at Baltimore, Md.

C. C. Rosser, who for many years has been connected with the Detroit Seamless Steel Tubes Company, Detroit, Mich., has been appointed district sales manager with offices at 1206 Guardian building, Cleveland, Ohio.

The National Safety Appliance Company, Chicago, has removed its offices from the Peoples Gas building to 1527 Railway Exchange building. The office of W. T. Tyler will remain in the Peoples Gas building.

The American Steel Foundries has leased the fifteenth and sixteenth floors of the Wrigley building annex, Chicago, for 10 years commencing May 1, 1924, at which time it will move its general offices from the McCormick building.

A. E. Bancroft has been appointed southwestern sales representative of the Union Metal Products Company and the Standard Railway Equipment Company, with headquarters at 2014 Railway Exchange building, St. Louis, Mo., succeeding the O'Fallon Railroad Supply Company.

J. A. MacLean, vice-president and general manager of the Boss Nut division of the American Bolt Corporation, has had his jurisdiction extended over three other divisions of the American Bolt Corporation, which are located at Detroit, Mich., Columbus, Ohio, and Bayonne, N. J.

J. C. Bloomfield, inspection engineer of R. W. Hunt & Co., Chicago, has been appointed district representative of the Industrial Works, with headquarters at 1051 McCormick building, Chicago, succeeding J. Shearer, who will be in charge of all branch offices, with headquarters at Bay City, Mich.

John N. Reynolds, formerly western manager of the Simmons-Boardman Publishing Company, publishers of the Railway Age and the *Railway Mechanical Engineer,* died in San Diego, California, on July 10. He retired from active service in 1913. Mr. Reynolds entered the service of the Railroad Gazette, a predecessor of the Railway Age in 1875.

Lawrence Wilcox, mechanical expert for the Westinghouse Air Brake Company, Chicago, has been transferred to Columbus, Ohio, as a representative of this company, and the Westinghouse Traction Brake Company. S. T. Reid, formerly a locomotive engineer on the Michigan Central, has been appointed mechanical expert in Chicago, succeeding Mr. Wilcox.

Leo Ehlbert, formerly with Engineering & Contracting, has been appointed Western representative with headquarters at 605 Fisher building, Chicago, of the Railway Equipment & Publication Company, New York publishers of the Pocket List and the Equipment Register, succeeding Charles L. Dinsmore, who has retired after 20 years of service as Western representative of this company. In tendering his resignation Mr. Dinsmore acted upon the advice of his physician who has been urging him to retire for the past year.

H. C. Berckes, of New Orleans, La., who has been assistant secretary since 1919 of the Southern Pine Association, was elected secretary-manager of the association to succeed J. E. Rhodes deceased, at a recent meeting of the board of directors. Mr. Berckes was born in New Orleans thirty years ago and has been connected with the Southern Pine Association staff almost since its organization in 1915. The directors, at the meeting, also decided to continue in the future the policy and activities which have been conducted by the association for the industry in the past.

William A. Frye, formerly air foreman at Kansas City, Mo., of the Missouri Pacific; S. H. Winslow, formerly with the Baltimore & Ohio in charge of road tests with the dynamometer car; R. P. Barnett, road foreman of engines of the Southern Railway, and Ernest Keathley, general foreman of the Southern shops at Knoxville, Tenn., have been appointed service engineers, and C. D. Lentz, formerly chief inspector of the New York Central locomotive repairs at the Baldwin Locomotive Works, has been appointed an inspector of the Franklin Railway Supply Company, Inc., New York City.

E. H. Batchelder, Jr., has opened offices in the Lytton building, Chicago, where he will engage in the handling of railway supplies. Mr. Batchelder was for some years employed by the Chicago & North Western in the operating and executive departments at Chicago, and was later promoted to secretary to the president. During federal control he was secretary to R. H. Aishton, regional director of the Northwestern region. Following the return of the railroads to the owners, he was appointed secretary to the president of the Union Pacific, with headquarters at Omaha, Neb., which position he resigned to enter the supply business.

A. F. Stuebing, mechanical department editor of the Railway Age and managing editor of the *Railway Mechanical Engineer,* has resigned to take a position as chief engineer of the Bradford Draft Gear Company, New York City. Mr. Stuebing attended Cornell University and the university of Illinois, and entered railroad service in 1910 as a machinist's helper on the Boston & Albany at West Springfield, Mass. In 1911, he became a special apprentice on the Pennsylvania at Columbus, Ohio, and in 1913 went with the Rock Island Lines, where he was inspector in the test department, roundhouse foreman, and general foreman. He joined the staff of the Railway Age in 1917 as associate editor in Chicago, and in 1919 was appointed mechanical department editor and managing editor of the *Railway Mechanical Engineer.*

A. F. Stuebing

The W. N. Matthews Company, manufacturers of mechanical painting equipment and railway electrical specialties, St. Louis, Mo., has been reorganized as the W. N. Matthews Corporation, with the same headquarters. W. N. Matthews continues as president of the new company and C. L. Matthews as vice-president and secretary. C. C. Fredericks, general manager of the W. N. Matthews Company has been elected vice-president and general manager of the new corporation and A. G. Williams has been appointed manager of railroad sales. Mr. Williams started as mechanical apprentice in the Altoona, Pa., shops of the Pennsylvania railroad and was promoted through various positions to that of engineer of motive power of the Southwestern region, with headquarters at St. Louis, Mo., which position he resigned on May 1 to take charge of the railroad sales of the mechanical painting equipment of the W. N. Matthews Corporation.

Harry D. Rohman, formerly vice-president and chief engineer of the Stone-Franklin Company, New York, has become associated with Robert C. Shaal in the R. C. S. Equipment Corporation, a company dealing in general railroad supplies with offices at 8 East Forty-first street, New York City. Mr. Rohman is a graduate mechanical and electrical engineer with extensive railroad experience, having been prominently identified with the car lighting field, and for several years was in close touch with rail-

road matters abroad. After graduating from the technical schools of Zurich, Switzerland, he entered the works of the Oerlikon Electrical Construction Company, and in 1903 qualified as an electrical engineer, with experience in high and low tension and a.c. and d.c. work, especially electric traction. Later he entered the service of J. Stone & Co., London, and in 1910 was appointed chief of the testing and experimental departments. In 1914 he was appointed chief assistant electrical engineer, and held that position until October 1, 1915, when he entered the service of the Franklin Railway Supply Company as chief electrical engineer. In 1919 he was appointed chief engineer of the Stone Franklin Company and later vice-president of the same company.

J. C. C. Holding, who has been appointed assistant to G. W. Struble, in the management of the newly-organized steel car sales department of the Bethlehem Steel Company, was for several years with the Midvale Steel & Ordnance Company. After many years' experience in the Structural Department of the Carnegie Steel Company, he resigned in 1917 to become connected with the Midvale Company in the order department. Later he was appointed manager of the railroad division and in 1921 he was appointed manager of the structural division, at the same time having supervision of sales of standard rails, steel freight cars and boiler tubes. Mr. Holding is a graduate of the Rose Polytechnic Institute, Terre Haute, Ind., and immediately after graduation became connected with the civil engineering department of the Johnson Company, now the Lorain works of the National Tube Company. He later spent several years in the structural drafting room of the Shiffler Bridge Works and the Keystone Bridge Works, Pittsburgh, both of which companies were later merged with the American Bridge Company. In 1901 he accepted a position in the office of the structural engineer of the Carnegie Steel Company and shortly after when the general sales department of the Carnegie Steel Company was re-organized and divided into bureaus, he was transferred to the structural bureau. He was with the Carnegie Steel Company for 16 years.

Captain Robert Woolston Hunt, president of Robert W. Hunt & Co., Chicago, died at his home in Chicago on July 11 at the age of 85. Captain Hunt was born on December 9, 1838, in Fallsington, Pa. He spent several years learning the practical side of iron making in the rolling mills of John Burnish & Co., Pottsville, Pa., and later took a course in analytical chemistry in the laboratory of Booth, Garrett & Blair, upon the completion of which he entered the employ of the Cambria Iron Works, Johnstown, Pa., where on August 1, 1860, he established the first laboratory in America as a direct part of an iron or steel organization. After serving in the Civil War he was employed in the experimental Bessemer works of the Cambria Iron Company at Wyandotte, Mich. He then returned to the Cambria Company at Johnstown to take charge of its steel business. While there engaged he had charge of the rolling of the first steel rails made in America on a commercial order.

R. W. Hunt

Later he assisted George Fritz, Cambria's chief engineer, in designing and building its Bessemer works, and assumed charge of it on its completion July 10, 1871. In 1888, he established the bureau of inspection, tests and consultation of Robert W. Hunt & Co., in Chicago.

Mr. Hunt was president of the American Institute of Mining Engineers in 1883, and again in 1906. He was president of the American Society of Mechanical Engineers in 1891, of the Western Society of Engineers in 1893, of the American Society for Testing Material in 1912, and in 1914 American vice-president of the International Association for Testing Materials. He was awarded the John Fritz medal in 1912 for his contributions to the early development of the Bessemer process.

TRADE PUBLICATIONS

Chucks.—The Skinner Chuck Company, New Britain, Conn., has recently issued a 20-page condensed catalogue of its line of lathe, drill and planer chucks, vises and face plate jaws.

Riveters.—The size and capacity of each type of riveter illustrated and the use for which each is best adapted are the features of the circular recently issued by the Hanna Engineering Works, Chicago.

Combination Buffer and Grinder.—The Hisey-Wolf Machine Company, Cincinnati, Ohio, has issued a two-page bulletin, No. 3014-S, describing a new direct motor driven combination grinding and buffing machine.

Sectionfold Partitions.—Details of the construction and operation of the Wilson sectionfold partitions and standard type doors are outlined in an illustrated folder recently issued by the J. G. Wilson Corporation, New York.

Electric Hoist.—The Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., has recently issued a 68-page illustrated booklet depicting the Shepard electric Liftabout hoist as it is used for moving and lifting loads of various kinds.

Locomotive Chart.—The Johns-Pratt Company, Hartford, Conn., is distributing a chart of a passenger type Mountain, or 4-8-2, locomotive on which the principal parts are numbered. Below the chart is a key giving the names of 385 parts with reference to I. C. C. rules in the "Laws, rules and instructions for inspection and testing locomotives."

Thread Grinding.—Instructions for setting up and operating multi-graduated Precision grinders and tables showing setting of grinding spindle to conform to Helix angle of thread are given in the 26-page booklet recently issued by the Precision & Thread Grinder Manufacturing Company, Philadelphia, Pa. The Precision and thread lead screw variator is also described in detail.

Kerosene Torches.—Wind and rain-proof portable torches for railway track, shop and locomotive service, etc., are described and illustrated in a four-page circular recently issued by the Chausse Oil Burner Company, Detroit, Mich. These torches burn in any position and are particularly adapted for thawing, drying, preheating, soldering, tempering, expanding and general shop use.

Gasoline Motor Coaches.—A folder has recently been issued by the Service Motors, Inc., Wabash, Ind., in which are illustrated a number of its model 55 motor coaches as they have been built for a number of steam railways. In addition to the specifications of the model 55 coach, it gives considerable data as to the cost of operating this equipment, which has been obtained from a number of users.

Air and Gas Compressors.—The Ingersoll-Rand Company, New York, has just issued a new 36-page, illustrated bulletin describing its Imperial type XPV steam driven air and gas compressors. In this bulletin particular attention is called to the steam valve gear used on these compressors, which consists of completely balanced piston valves with riding cutoff valves which telescope within the main valves.

Ferro Carbon Titanium.—The Titanium Alloy Mfg. Company, Niagara Falls, N. Y., has issued a small 44-page booklet describing ferro carbon titanium and its function in the manufacture of steel. In addition to a detailed description of the properties of this alloy, this booklet contains valuable data comparing the properties of untreated steel with those of steel to which titanium has been added. Numerous photographs are also presented showing the properties of this metal.

Tool and Cutter Grinding.—A tool grinding handbook, including a catalogue of universal tool and cutter grinding machines, has recently been issued by the Norton Company, Worcester, Mass. The book contains 117 illustrated pages and begins with a description of tool and cutter grinding. The following chapters deal with wheels for tool and cutter grinding, the general grinding procedure, and problems in tool and cutter grinding, the latter being adapted to makes of machines other than the Norton types for which they are especially applicable.

EQUIPMENT AND SHOPS

Locomotive Orders

THE NEW YORK CENTRAL has ordered 5 Shay geared locomotives from the Lima Locomotive Works.

THE VIRGINIAN has ordered 36 electric motive power units from the American Locomotive Company and the Westinghouse Electric & Manufacturing Company.

Passenger Car Orders

THE SOUTHERN PACIFIC has ordered 16 steel baggage and buffet cars from the American Car & Foundry Company.

THE PACIFIC ELECTRIC has ordered 50 electric motor coaches, 42 ft. long from the Standard Steel Car Company.

Freight Car Orders

THE CHICAGO GREAT WESTERN has ordered 300 box cars from the Pullman Company.

THE SOUTHERN RAILWAY has placed an order for 1,000 steel center constructions for box cars.

THE UNION RAILROAD will have 100 Clark dump cars built in the shops of the Greenville Steel Car Company.

THE SOUTH AFRICAN RAILWAYS has ordered 100 grain cars in England from the Metropolitan Carriage & Wagon Works, Ltd.

THE KANSAS CITY SOUTHERN has ordered 500 steel frame, single sheathed box cars of 40 tons' capacity from the Pennsylvania Car Company, Kansas City, Mo.

THE CANADIAN NATIONAL has ordered 750 box cars of 50 tons' capacity from the Canadian Car & Foundry Company, and 250 from the National Steel Car Corporation.

THE CANADIAN PACIFIC is having 1,000 steel underframe, double sheathed box cars 36 ft. long, also 300 steel frame, automobile cars 40 ft. 6 in. long, built in its Angus shops.

Freight Car Repairs

THE CENTRAL OF NEW JERSEY will have repairs made to 300 hopper cars in the shops of the Middletown Car Company.

THE ERIE is having repairs made to 200 produce cars at the shops of the Illinois Car Company, and is also having repairs made to 200 gondola cars at the shops of the Greenville Steel Car Company.

THE LEHIGH & NEW ENGLAND has placed an order with the Magor Car Corporation to repair 150 steel hopper cars and an order has been placed with the Middletown Car Company for repairing 150 steel hopper cars.

THE NEW YORK CENTRAL has let contracts for converting 500 old box cars to double deck stock cars to the Standard Tank Car Company; 500 old box cars to single deck stock cars to the American Car & Foundry Company; 500 old gondola cars to flat cars let to the Pennsylvania Tank Car Company; and 500 old gondola cars to flat cars let to the Steel Car Company. This company has also given a contract to the Merchants' Dispatch Transportation Company for the repair of 500 freight cars.

Machinery and Tools

FLORIDA EAST COAST has placed an order for a 42-in. boring mill.

THE TENNESSEE CENTRAL has placed an order for an 18-in. slotter.

THE CENTRAL OF NEW JERSEY has placed an order for a 42-in. planer.

THE UNION PACIFIC has placed an order for a 1,500-lb. steam hammer.

THE VIRGINIAN has placed an order for a 500-ton double end wheel press.

CHICAGO, ROCK ISLAND & PACIFIC has placed an order for a 53-in. boring mill.

THE ST. LOUIS-SAN FRANCISCO has placed an order for a 600-ton, 96-in. wheel press.

THE MISSOURI PACIFIC has ordered one 200-ton transfer table and one 15-ton electric crane from the Whiting Corporation.

THE NORFOLK & WESTERN has placed orders for a number of tools including a 73-in. boring mill, axle lathe, 42-in. boring mill and 600-lb. hammer.

THE DENVER & RIO GRANDE WESTERN has ordered 16, 7½ ton one-motor 17 ft. span overhead traveling cranes and two, 7½ ton 14 ft. span two-motor overhead traveling cranes from Alfred Box & Co. The company has also placed an order for one 90-in. driving wheel lathe.

THE AMERICAN LOCOMOTIVE COMPANY has placed orders for a 6-ft. radial drill, a double traveling head shaper, a locomotive axle and journal turning lathe, a 100-in. wheel boring and turning mill, a 60-in. planer and a 32-in. shaper; also for a 50-in. boring mill and a 5-ft. radial drill.

Shops and Terminals

IN A FIRE AT DEPEW, N. Y., on July 8, the office and stock room of the New York Central car shops were badly damaged. Estimated loss $50,000.

PENNSYLVANIA.—This company has commenced the construction of a new two-story machine shop at Mt. Vernon, Ohio, to replace a building recently destroyed by fire.

WESTERN PACIFIC.—This company has awarded a contract to the W. Murcell Company, San Francisco, for the construction of an addition to its locomotive and car shops at Sacramento, Cal.

MOBILE & OHIO.—This company has awarded a contract to Keeley Brothers Contracting Company, East St. Louis, Ill., for the construction of a roundhouse and shop building at Jackson, Tenn.

PERE MARQUETTE.—This company has awarded a contract to M. Babbitt & Sons, Toledo, Ohio, for the construction of terminal facilities at Erie, Mich., including a 16-stall roundhouse and a machine shop.

SOUTHERN PACIFIC.—This company has authorized the construction of a locomotive assembly shop at Los Angeles, Cal., to cost approximately $500,000. Construction of the new building will start in the fall.

FIRE damaged the shops of the Kansas City Southern at Shreveport, La., on July 11, destroying a building 500 ft. long and 85 ft. wide and 72 box cars at an estimated loss of $200,000. The origin of the fire was not determined.

MICHIGAN CENTRAL.—This company has awarded a contract to the Ellington Miller Company, Chicago, for the construction of an 8-stall, reinforced concrete roundhouse, a boiler house, an office building and sanding facilities at Grand Rapids, Mich., to cost approximately $100,000.

ATCHISON, TOPEKA & SANTA FE.—This company has awarded a contract to the Truscon Steel Company for the material and erection of two of its standard steel buildings 50 ft. by 64 ft. and 32 ft. by 150 ft. respectively for its timber preserving plant now under construction at National City, Cal.

PENNSYLVANIA.—An appropriation of $500,000 has been made for the construction of a masonry dam in Tipton Valley about ten miles east of Altoona, to supply the shops and railroad yards with an adequate quantity of water. Over nine million gallons of water are consumed every working day by these shops; almost double the quantity used by the entire city of Altoona, with its population of 70,000. The new dam will be about 400 ft. long, 78 ft. high and 60 ft. thick at the base. It will involve 18,000 cu. yd. of excavation and will make a lake 32 acres in extent, with a capacity of 250 million gallons. Tipton Run is a pure mountain stream very desrable for locomotive uses.

PERSONAL MENTION

General

F. F. CARBERRY, general fuel supervisor of the Missouri Pacific, with headquarters at St. Louis, Mo., has been appointed superintendent of fuel conservation, with the same headquarters.

G. N. DEGUIRE has been appointed manager of the Department of Equipment, United States Railroad Commission, succeeding Frank McManamy, who has been appointed Interstate Commerce Commissioner.

C. L. DICKERT, master mechanic on the Central of Georgia with headquarters at Macon, Ga., has been promoted to superintendent of motive power with headquarters at Savannah, Ga., succeeding W. H. Fetner, resigned.

H. A. MACBETH, assistant superintendent of motive power of the New York, Chicago & St. Louis, with headquarters at Conneaut, Ohio, has been appointed superintendent of motive power and cars of the Wheeling & Lake Erie, with headquarters at Brewster, Ohio, succeeding M. J. McGraw.

OWEN J. BROWN, whose appointment as superintendent of fuel service of the Boston & Maine was announced in the July issue of the *Railway Mechanical Engineer,* was born on June 5, 1886, at Peoria, Ill. He entered railway service with the Illinois Valley Belt (the operation of which has since been discontinued) as a fireman in 1906 and a year later became a yard clerk. In 1911 he entered the service of the Wabash as a clerk in the company's general offices and the following year was appointed fuel inspector. Three years later he was promoted to fuel accountant and in 1916 he entered the service of the Boston & Maine as inspector of fuel service, which position he was holding at the time of his recent promotion. Mr. Brown had experience in coal mining before he entered railway service. He is a member of the executive committee of the International Railway Fuel Association.

O. J. Brown

Master Mechanics and Road Foremen

I. E. SANDERS has been appointed master mechanic of the Louisiana Railway & Navigation Company of Texas, with headquarters at Greenville, Tex.

A. J. FLOWERS, master mechanic on the Central of Georgia, with headquarters at Columbus, Ga., has been transferred to Macon, Ga., succeeding C. L. Dickert. W. A. McCafferty, assistant master mechanic, with headquarters at Macon, has been promoted to master mechanic, with headquarters at Columbus, Ga., succeeding Mr. Flowers. E. L. Cox has been appointed assistant master mechanic, with headquarters at Macon, succeeding Mr. McCafferty.

OSCAR G. MCPHAIL, whose appointment as master mechanic of the Cumberland & Manchester with headquarters at Barbourville, Ky., was announced in the July issue of the *Railway Mechanical Engineer,* was born on July 24, 1878, at Columbus, Ga. After graduating from school in 1894, Mr. McPhail took a special course in mechanical engineering and drafting, entering the employ of the Georgia, Midland & Gulf in January, 1896, as a machinist apprentice. In 1900, he became a locomotive engineer on the Southern Railway in which the Georgia, Midland & Gulf had been absorbed. From 1904, he subsequently served as roundhouse foreman of the Seaboard Air Line at Savannah, Ga., and air brake man and instructor of the Central of Georgia at Columbus, in 1907 returning to engine service on the Columbus Division of the Central of Georgia. From October, 1913, until his recent appointment, he was roundhouse foreman of the Atlanta, Birmingham & Atlantic under J. F. Sheahan, superintendent of motive power; general foreman at Fitzgerald, Ga., and master mechanic.

Car Department

E. G. CHENOWETH, mechanical engineer of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been promoted to superintendent of the car department, with the same headquarters, succeeding J. H. Milton, who has been appointed general foreman, car department, of the Terminal division, with headquarters at Chicago. Mr. Chenoweth was born on December 18, 1875, at Union City, Ind., and attended Purdue University from 1895 to 1898. He entered railway service in 1895 as a special apprentice on the Erie at Huntington, Ind., and until 1901 was employed consecutively as machinist, air brake instructor and foreman of the air brake department. He was appointed draftsman on the Pennsylvania at Altoona, Pa., in 1901, later serving in the same capacity on the Pere Marquette, the Lake Shore & Michigan Southern and the Philadelphia & Reading. Mr. Chenoweth was appointed mechanical engineer of the Erie, with headquarters at Meadville, Pa., in 1906. In July, 1913, he was appointed assistant superintendent of the car department of the Chicago, Rock Island & Pacific, with headquarters at Chicago, being promoted a year later to mechanical engineer in charge of car design. He was appointed mechanical engineer in charge of locomotive and car design in November, 1918, which position he held at the time of his recent promotion to superintendent of the car department.

E. G. Chenoweth

Shop and Enginehouse

M. J. MCGRAW has been appointed superintendent of shops of the Seaboard Air Line, with headquarters at Jacksonville, Fla.

Purchasing and Stores

A. F. SCHMUHL has been appointed general lumber agent of the Pullman Company with headquarters at Chicago, succeeding A. F. Jones, assigned to other duties.

Obituary

L. W. HENDRICKS, mechanical superintendent of the Bangor & Aroostook with headquarters at Derby, Me., was killed in an automobile accident near St. Agatha, Me., on July 12.

WILLIAM MOIR, retired mechanical superintendent of the Northern Pacific, died on June 26 at Tacoma, Wash. Mr. Moir was born on July 7, 1851, at Dundee, Scotland. Previous to his employment with the Northern Pacific, Mr. Moir was associated with the Brooks Locomotive Works at Paterson, N. J., and with the Missouri, Kansas & Texas at Parsons, Kan. In 1881 he was appointed general foreman of the Northern Pacific at Sprague, Wash., and shortly after was promoted to master mechanic. He was then transferred to Spokane, Wash., in the same capacity and in 1903 was promoted to shop superintendent and after a short period was again promoted to general master mechanic of the Western district with headquarters at Tacoma. In 1906 Mr. Moir was appointed mechanical superintendent with headquarters at St. Paul, Minn., in which capacity he served for several years and on May 1, 1911, he retired from active service.